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THE TREATMENT OF OPEN WOUNDS

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FUNDAMENTALLY, the treatment of any open wound consists of aiding Nature to repair the defect, in the shortest time, with a minimum of cutaneous and subcutaneous scarring. Our efforts to help, therefore, should be directed toward instituting only those measures which will accomplish a definite beneficial end but will interfere least with the local reparative processes. This obviously bespeaks a thorough conception of what is known of the processes of repair and of regeneration in the various tissues of the body.

The term "open wound" in its broadest sense implies the inclusion of all examples of dissolution of tissue continuity, ranging from a trivial traumatic wound to the large wounds of deliberate surgical procedure.

Largely because of disruption of the normal elastic tension of the integuments and other factors dependent on size and shape, the problem most difficult for Nature to cope with, in all but the smallest wounds, is that of primary closure. Conversely, it is this difficulty that is most easily remedied by the mechanical aids of suture or bandage. Divergent views are held on the propriety of early closure in many surgical and in most traumatic wounds. We believe that if the character of the wound warrants it, early accurate apposition of its surfaces will fulfill most completely the terms of our original definition.

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I have spoken of the character of a wound as the conditioning factor of early closure, but we are so accustomed to think carelessly of the character of wounds as "clean" or "dirty" that several notes of warning should be sounded. One is that the "cleanliness" of a wound is only relative, and that some contamination is always present. Another is that the physical characteristics of the wound surfaces with regard to such matters as the presence of infiltrative hemorrhage, crushed tissue in the smallest amount, or tissue devitalized by occlusion of its blood supply are too frequently overlooked and disregarded. The third is that there is a tendency to overlook the fitness of the patient to carry on all the physiological processes necessary for prompt healing. It was the acute sense of, and constant regard for, the delicacy of all tissues and their extraordinary powers of repair under suitable conditions, that in their own times marked Paré, Lister, and Halsted out from among their surgical contemporaries and made them not only great but the greatest of surgical masters. It is only by the constant practice in detail of treatment based on such fundamental concepts that any of us have the right to call ourselves their disciples. It is of these physiological factors and of the possibilities of successful early closure of accidental wounds that my colleagues, Drs. Howes and Ferguson, are going to speak to you in a few minutes.

As you well know, the conditions present in many wounds at their inception are often far from

ideal, so that when we first see them, immediate closure is out of the question. In the treatment of wounds of this type, whole categories of agents confront us: physical agents, such as heat, sunlight, and ultraviolet or roentgen rays; chemicals, such as solutions or ointments with germicidal and bacteriostatic properties, or alleged powers of stimulating epithelial growth and of inhibiting granulation tissue; and finally remedies which may be loosely termed physiological, such as saline solution, maggot extract, insulin, vitamins, rest, posture, and passive motion. From these we may choose, and our choice will be wise if it is based on concepts of simplicity, directness of action, specific applicability to the wound in question, and, above all, furtherance and not inhibition of natural physiological processes. To illustrate the foregoing statement, I would like to mention certain investigations carried on in our hospital by Frank W. Hartman. This work began two or three years ago in connection with efforts to add an effective antiseptic agent to tannic acid in the Davidson treatment of burns. Having used tricresol in the preparation of bacterial vaccines, and being impressed with its effectiveness as well as its seemingly limited destruction of tissue when injected subcutaneously, he synthetized and tested various other higher cresols, fixing finally on two preparations, hexochloro-m-cresol and dichlorohexylresorcinol. Being used according to the method of Salle and Lazarus, these two compounds were compared with other commonly used antiseptics with the following results: hexochloro-m-cresol 0.019; tincture of iodine 0.03; dichlorohexylresorcinol 0.08; merthiolate 26.0; mercurochrome 35.0; and metaphen 44.0. These figures show how comparatively non-injurious the higher cresol and resorcinol compounds are for tissue cells, yet they retain an active antiseptic value in dilutions from 1 to 2,000 to 1 to 3,000. It is about the care of the more complicated open wounds that my colleague, Dr. Reid, will speak, and about which I myself may have some things to say later on in the discussion.

Time, knowledge, experiment, and experience have largely eliminated the use of substances really detrimental to the healing of open wounds. Yet in employing various of the more rational, harmless yet helpful products in current use, one wonders if most of us do not overlook the inherent powers of the human body and fall too easily into stereotyped and empirical use of these agents without weighing the real necessity for their use. A final item in the treatment of wounds is the dressing itself. The type of dressings, their support, their frequency, and above all the technique of their practice are important and are subject to great variations, and I hope this phase of the subject will receive due attention during our session.

A type of wound in which proper treatment is of the greatest importance is the severe burn. Since E. C. Davidson, late resident surgeon at our hospital, worked out the tannic-acid treatment of burns which bears his name, we have always had the greatest personal interest in this subject. Davidson pointed out in his original contribution the equal importance of the prevention, or treatment, of shock, and the need for absolute asepsis. We still believe that the tannic-acid treatment is most satisfactory if surgical principles are observed, and that aseptic methods are always of much more importance than antiseptic solutions. These two great principles, fundamental in all types of wounds, should be observed in the treatment of burns. Therefore, if the physician or surgeon would simply regard a burn as a surgical wound to be kept surgically clean, much of the problem of healing would be solved.

In the above paragraphs I have tried to indicate what seem to me the basic problems in the treatment of wounds and to sketch the framework of what I hope will be a profitable discussion.

THE TREATMENT OF OPEN TRAUMATIC WOUNDS

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THE problem in the treatment of the open traumatic wound is one of conversion of a lacerated and contused, potentially infected, wound into one which is surgically fresh and clean. If this can be accomplished, primary healing may be expected.

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In the treatment of such wounds it should be remembered that bacterial invasion of the tissues probably does not take place for six hours. There should be hardly a wound then that could not receive adequate treatment while the bacteria are still on its surface. It should also be recalled to mind that healthy living cells have a remarkable power to combat bacteria. The problem then re-

solves itself into removal of dead and devitalized tissue and protection of viable tissue from damage.

Before mechanically cleansing the wound, it is necessary to prepare the surrounding skin tissue. The wound is protected with sterile gauze and the surrounding skin liberally washed with soap and water. If there is much grease, benzine or ether may be used in addition, but the liberal use of soap and vigorous scrubbing gives the best preparation of the surrounding skin tissues. After the skin has been dried with sterile gauze, some form of skin antiseptic may be applied if desired. Unless the wound is very extensive, the remaining portion of the mechanical cleansing may be carried out under local anesthesia. The anesthetic solution is introduced from the surrounding uninjured skin so as to build a wall of anesthetic to surround the traumatic wound. One-half or one per cent of procaine hydrochloride gives excellent anesthesia.

Removal of dead and devitalized tissue should be accomplished by sharp excision. In so doing, the surgeon should remember that the tissues having the poorest blood supply, the fascia, tendons, and fat, are those which are most easily damaged by trauma and have the poorest natural resistance to infection. These tissues should be excised if there is the slightest doubt as to their viability. Muscle, and especially skin, may be treated with more conservatism.

Under the head of protection of viable tissue from damage should be listed the principles of the handling of any surgical wound. Care and gentleness are of paramount importance. The avoidance of crushing instruments and the prevention of trauma by retraction are well known but frequently neglected principles. Sharp retraction with sharp rakes, towel clips, or tension sutures may be recommended to avoid wound trauma.

The control of bleeding must be carried out with the thought of preventing tissue injury constantly in mind. As a rule, it may be delayed until the wound is ready for closure, by which time many of the smaller vessels may have closed. In the application of hemostats, only the bleeding point should be caught in order that the smallest possible stump of devitalized tissue is left beyond the ligature. The vessels just beneath the skin rarely need ligation and many bleeding points may be controlled by hemostat crush without ligation. In wounds of the extremities, especially those below the elbow and knee, a blood-pressure cuff used as a tourniquet will permit careful, rapid work without the necessity of sponging.

Foreign bodies, and blood clots which act as foreign bodies, should be removed because they harbor and encourage bacterial growth and prevent normal wound healing. These are best removed mechanically, by flushing the wound with generous quantities of warm physiological saline solution. The use of antiseptic solutions, if not definitely harmful, certainly contributes nothing to the healing of the wound. If a wound heals well when antiseptics have been used, it heals in spite of the antiseptics rather than because of them.

The wound should be closed so as to avoid dead space, where blood clots and serum collections may encourage bacterial growth and delay the normal processes of wound repair. Dead space may be partly obliterated by the use of a few judiciously placed, buried sutures, with a snug dressing for additional obliterating pressure. The suture and ligature materials should be chosen and placed with a view toward minimizing injury to the wound tissues. Catgut has been shown by numerous investigations (Babcock (1 and 2), Howes and Harvey (3), Whipple (4)) to act "not only as a foreign body but a foreign body which induces exudation reaction, and therefore delays healing" (3). If it is to be used at all, it should be used in very small sizes, oo and ooo, and cut exactly at the knot. It is much better to use material which produces little or no reaction in the tissues, and in this respect fine silk or fine alloy steel wire are excellent. In our experience the steel wire has been by far the best material. It is fine and easily tied, and even when buried in the tissues, it apparently causes no foreign-body or other untoward reaction. In suturing the wound, the sutures should not be tied so tight as to crush the tissues. The skin sutures should be interrupted and tied just tight enough to approximate the wound edges, as subsequent edema may increase the tension at the suture for the first few postoperative days.

It is desirable to obtain a skin covering in an open wound as early as possible and, if a thorough mechanical cleansing has been accomplished, a primary split-thickness skin graft may be applied where there has been a loss of surface covering. Or it may be possible to close a wound by the use of relaxing incisions. In any event, an effort should be made whenever possible to convert an open wound into a closed one at the earliest possible moment, preferably at the first operation. Drainage is not employed unless there is oozing which has not been controlled by ligature. When the trauma has involved the deeper muscle tissues or bone, a considerable and rapid swelling and tension in the part may be expected. In such cases long relaxing incisions must be made

throughout the entire length of the part involved on one or both sides.

The dressing should be applied so as to give elastic pressure to the area of the wound. The pressure of moist sea sponges is ideal, but fluff gauze snugly bandaged in place will serve very well. On the extremities, it is wise to insure physiological rest by appropriate splinting. The part should be elevated for the first four or five postoperative days. This is the best prophylaxis against the development of an edema which reduces the effective capillary flow, produces pain, and delays healing. Dressings should not be changed until the sutures are to be removed, unless local signs and symptoms indicate an infective inflammatory reaction. If desired, the outer dressings may be changed as they become soiled, but the dressing next to the wound should be allowed to remain in place. The dried blood and serum adherent to the wound form the most effective moulded splint that could be provided.

It is probable that fibroplasia and eventual healing is somewhat more delayed in the traumatic wound than in the usual surgical wound. It is therefore frequently wise to leave the wound untouched and the sutures in place for from ten to fourteen days or even longer. In some cases of compound fracture, I have left steel-wire sutures in place for three months without any reaction about the sutures.

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THE RELATIONSHIP OF THE GENERAL CONDITION OF THE PATIENT TO THE HEALING OF THE OPEN WOUND

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THE open wound heals in two definite phases. During the first or lag phase the size of the defect does not change, the vascular reaction occurs, exudation and phagocytosis take place, lysis of necrotic material goes on, and foreign bodies are extruded. This period lasts four or five days in healing *per primum* and is proportionately prolonged by excessive amounts of necrotic tissue, by the presence of foreign bodies, and by infection. In the second phase the defect rapidly diminishes in size. Contraction of the surrounding uninjured tissue accounts for the greater portion of the reduction in size, and the processes of fibroplasia and epithelization complete the closure. The second phase begins only when the first is finished. In healing *per primum* the second phase starts at approximately the same time throughout the length and breadth of the wound, whereas in untoward healing there is considerable variation in the initiation of the second phase in different portions of the wound. With infection the second phase proceeds irregularly or might even cease to progress.

In other words, the local condition in the wound determines the duration and character of the phases, but occasionally the general condition of the patient becomes the dominant influencing factor. These changes in the general condition of the patient which influence wound healing are related to the state of nutrition, the circulation, disease elsewhere, and resistance to bacterial invasion.

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The age of the patient has a direct influence on the length of the lag period. It is shorter in the very young and tends to lengthen with age. The index of cicatrization increases with age, while the rate of fibroplasia is less retarded in the young.

Because the regeneration of tissue during healing is really a growth phenomenon, diet affects the character of the second phase. A diet rich in casein stimulates the rate of fibroplasia, while a diet rich in fat retards it. No definite proof can be offered, however, that changes in the carbohydrate metabolism influence the character of the second phase of the healing except as the indirect result of disturbing the first phase. Clinically, diabetes predisposes to infection and prolongs the first period, while correction of the hyperglycemia by the use of insulin quickly turns the balance and healing takes place. There is no conclusive evidence that insulin used locally or in the absence of diabetes stimulates repair. Dehydration markedly retards the entire healing process. Clinically, the poor healing of wounds in dehydrated children with pyloric stenosis is well known. Experimentally, the rate of fibroplasia is slowed up in animals not receiving an adequate intake of water.

Recently it has been shown that C-avitaminosis markedly changes the character of fibroplasia. Fibroblasts appear as well as the reticular network, but the collagenous fibers do not mature properly. Consequently, incised wounds do not gain their expected strength and are apt to disrupt and produce an open wound. Prevention of disruption, of course, prevents the occurrence of an open wound, and, as subclinical scurvy is apparently more prevalent than generally supposed, especially in patients with cancer, the suggestion has been made that a deficiency of Vitamin C should be sought by chemical means and, if present, corrected by the administration of ascorbutic acid. No didactic statements can be made on the influence of the other vitamin deficiencies on wound healing because in spite of an abundance of investigations, the interrelationship of these deficiencies to the general metabolism is so complex that interpretations are difficult. The problem of Vitamin-A deficiency may be briefly mentioned however. Normal epithelium undergoes distinct changes in morphology when there is a deficiency of this vitamin; and the healing of open wounds is said to be benefited by an adequate intake of Vitamin A. For this reason, cod-liver oil has been applied locally to open wounds, but recent work tends to show that some other property of the oil other than its vitamin content is responsible for the hastening of the repair. Other workers question whether cod-liver oil stimulates wound healing at all. Clinical observations on the stimulating properties of local applications are apt to be enthusiastic.

The beneficial effect of an adequate circulation in stimulating healing and, conversely, the detrimental influence of local or general anemia are too well known to require more than a mention. The effect of increasing the temperature of the body in general or of the part involved is related to the question of the efficiency of the circulation. The rate of cicatrization of open wounds is speeded up experimentally by increasing the body temperature, and the rate of fibroplasia is improved by increasing body heat. The cradle and light have been used clinically for some time to stimulate the healing of open wounds, particularly on extremities with poor circulation.

Syphilis and tuberculosis are general diseases which are frequently accused of delaying the healing of the wound. There is no definite proof, however, that they do so, unless they are actually present in the wound. On the other hand, purulent infection elsewhere delays wound healing experimentally, but, so often clinically, when the adverse effect of disease elsewhere is considered, the question must always be asked whether the disease itself or some secondary change in the metabolism incident to the disease is the cause. Poor healing, for example, is notorious in patients with lymphogranuloma inguinale; yet when the anemia is corrected by transfusions, and an adequate intake of protein and vitamins is provided, the wounds heal promptly although the disease is still present.

With the recent reintroduction of general chemotherapy in the treatment of established streptococcal infection, it was but natural that sulfanilamide should be used to prevent infection by this micro-organism and by the bacillus welchii. These are the two most feared. We have given prophylactic doses of sulfanilamide in the early treatment of open wounds and have believed that in several cases beneficial effects were obtained. In these cases the toilet of badly traumatized wounds could not be adequately carried out, or the patients presented themselves too late after injury for débridement to be performed. It must be emphasized, however, that under no circumstances must the toilet of the wound be neglected. The combination of foreign body or dead tissue plus bacteria is a powerful one for producing infection and can hardly be defeated by the use of a drug alone. It is better to remove the foreign body and the dead tissue. Too often, the local toilet of the open wound is neglected simply because the wound is going to be left open.

Lastly, the question arises whether any change in the general condition of the patient, a change in nutrition, circulation, or chemotherapy, would produce an unusually rapid rate of healing. Such an advantage is seldom required. Most patients presenting themselves with open wounds, which are usually traumatic, have an adequate circulation and a balanced metabolism. On the other hand, in the small group of cases in which the general factors might delay healing the condition is easily recognized: diabetes, dehydration, malnutrition, or nephritis. If wounds become chronic or fail to heal, the general condition of the patient must be considered, of course; but in the majority of instances, there is more likely to be a local fault, a symbiotic or unusual bacterial flora, a sclerotic base, sloughing fascia, exposed bone, or infection in the bone. When these faults are corrected by the surgeon, it is generally found that the healing rate of the tissues is all that may be desired.

COMPLICATED WOUNDS

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COMPLICATED wounds which, by reason of their nature or the condition of the patient, cannot be closed do not, to my mind, alter any of our fundamental principles of the treatment of wounds. In such cases one paramount principle is that the life of the patient must always be considered. In the handling of these more serious wounds an easy mistake is to treat the wound at the expense of a life. It is often better to apply a sterile dressing and a splint and do nothing more to the wound until the patient's general condition can be improved to the point where the risk of treating the wound may be materially lessened. This may even delay the treatment of the wound beyond six hours or into the period when wounds must be regarded as infected and not just soiled. This evaluation of what a patient can stand in the presence of a severe wound is difficult. The pulse may often belie the true condition of the patient who may not be able to stand much manipulation. This is true particularly when there has been great loss of blood or compound injury of the bones and joints. The establishment of blood banks with a ready supply of blood will undoubtedly save many lives in cases in which mistakes in judgment are made as to how much the patient can stand. The apparently good risk can go into shock astonishingly fast and it is my belief that in the case of all severe and complicated wounds a supply of proper blood should be on hand before operative procedures are begun.

With these reservations let us assume for purposes of discussion today that the ideal therapy may be employed in the cases of soiled severe wounds which cannot be treated by the ideal therapy of cleansing and primary closure as outlined by other discussants. In such cases I believe there is even greater justification for the most careful cleansing of the wound, such as the removal of all foreign bodies; the elimination of blood clots, and dead and devitalized tissues; and the careful washing of the wound with salt solution and with neutral soap and water, if necessary, to clean any greasy and dirt-stained living tissues. Dirty bits of bone and cartilage which cannot be cleaned may be removed by a sharp chisel or knife. I believe it well nigh criminal to reason that because such a wound is going to be left open it can be packed with gauze with very little attention to the toilet of the wound. After all it is going to be denied the normal protection of skin and mucous membrane, and until its next best protection, granulation tissue, forms, it will readily disseminate bacteria and toxic substances through its open lymphatic and vascular capillaries. In this connection I am assuming that primary grafting, which should always be done whenever possible, and which demands the most meticulous cleansing of the wound, cannot be done for some reason.

After the thorough cleansing of a complicated wound which cannot be closed or grafted, the next problem is to secure for that wound the protection of granulation tissue as soon as possible. One sure way to handicap the formation of granulation tissue is by frequent dressing with gauze packing which steals away the very food which granulation tissue must have for its growth and, besides, constantly opens up new channels for the spread of infection. Muscular and joint action and mechanical manipulation of such a wound do almost as much damage to this food, and in addition cause hemorrhage and damage to the living cells, and open up channels for the spread of infection.

Thus my feeling about such wounds is that after the most careful primary toilet of them they should be disturbed even less than wounds treated by primary closure; that they should be absolutely fixed; and that the substance which comes in contact with such a wound should not absorb, stick, or in any way steal away the food needed for the growth of granulation tissue. For this substance I prefer vaseline or paraffine, when its use is possible, or vaseline-soaked gauze, when necessary, for the oozing of blood from points which do not justify the necrosis of ligatures.

The practical application of this philosophy is illustrated by the following case: a young girl of fourteen years received in an automobile accident an extensive laceration and contusion of the left thigh. A large triangular flap of skin and muscle was turned upward from just above the knee. The wound extended from the mesial side of the thigh across the top to the lateral aspect where it met a vertical laceration which extended upward for more than 6 inches. The muscles were torn and loosened up as far as the greater trochanter and exposed the bone, from which a considerable area of periosteum had been removed. The tissues were badly stained and there were many stones of

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varying sizes throughout the extent of the wound. After a painstaking irrigation, débridement, washing with soap and water and again with salt solution, requiring more than an hour, the triangular flap of skin and subcutaneous tissue were gently laid back and sutured with 3 sutures which failed by 1½ in. to approximate the skin edges. No buried sutures were placed in the wound. A large vaseline dressing was applied and the leg was encased in a large plaster spica which included the abdomen and foot. Although this patient was unconscious from a concussion of the brain and incontinent for three days, during which the dressings became soaked with urine, another dressing was not made for ten days. Healing was by first intention except for the gaping, where there was healthy granulation tissue.

This patient was given gas-bacillus antitoxin in addition to tetanus antitoxin, a procedure we always follow in cases of severe and complicated wounds.

The protection of granulation tissue is another problem which I have discussed in my published papers, but for which there is not time today. Suffice it to say that we prepare such granulating wounds for secondary closure or skin grafting by using the Carrel-Dakin solution, and that we alternate between its use to control infection and use of tissue-growing procedures, when we depend upon epithelization from the edges for healing.

In connection with this subject do not forget what Billroth said nearly seventy-five years ago: "If you inject a drachm of putrid fluid into the subcutaneous cellular tissues of a dog, the result will be inflammation, fever and septicemia. If you make a large granulating surface on a dog, and dress it daily with charpie soaked in putrid fluid, it will have no decided effect. On the borders of the inflammatory new formation the lymphatic vessels are closed; on the granulating surface there are no open lymphatic vessels, hence no reabsorption takes place."

Questions and Answers

Question: What is the dosage of sulfanilamide?

DR. HOWES: Because of the dangers of untoward reactions from sulfanilamide, a small dose, 10 gr. t.i.d., should be given during the first twenty-four hours. A full therapeutic dose is given during the next two days with a gradual reduction in the amount during the third and fourth days. On account of its hemolytic action sulfanilamide should not be given to patients who have anemia because of marked blood loss, unless transfusions are also given.

Question: How does hypoproteinemia affect the healing of wounds?

DR. HOWES: While I have no absolute proof that hypoproteinemia affects wound healing, I would say that, because of the analogy between healing and the growth phenomena in general and because hypoproteinemia when extreme produces edema, healing would be retarded by hypoproteinemia. In acute starvation in adult rats no change in the rate of fibroplasia was found, but in young rats a definite retardation of the process was observed. It is doubtful, however, whether these animals had a true hypoproteinemia.

Question: When should a primarily closed wound be dressed, and how often?

DR. FERGUSON: Dressings of primarily closed wounds should not be changed unless there is some reason for the change. The less the wound is disturbed by removal of the dressings, the more rapid the healing. The reasons for change of dressings are: (1) removal of sutures, (2) suspicion of inflammatory reaction (infection?) in the wound, and (3) insecure or soiled dressing. The removal of skin sutures should usually be the reason for the first dressing of the wound. The sutures may be removed from the fifth to the tenth day after wound closure. With silk or fine alloy steel wire, the sutures may be allowed to remain in place even longer without fear of reaction in the wound.

Inflammatory reaction in the wound due either to tissue edema following trauma or to infection is indicated by pain and swelling in the region of the wound. This usually appears on the fourth or fifth day after suture, and the wound should be inspected and appropriate treatment given. If the pain is due simply to tissue edema, elevation and the application of evaporating solutions, such as 70 per cent alcohol, have been found helpful. If there is definite evidence of infection, the sutures should be removed, the wound edges separated, and hot moist dressings applied.

Insecure or soiled dressings should be replaced with neat snug dressings. Usually the gauze next to the wound need not be disturbed, only the outside dressings and bandage being replaced. As a rule there is little necessity for changing the dressings on an uncomplicated primarily closing traumatic wound more often than every five days.

Question: What should be done as first-aid treatment in open wounds?

DR. FERGUSON: As a rule the least done in the first-aid treatment of open wounds, the better. An attempt should be made to stop the bleeding by pressure or, if necessary, with a tourniquet. The wound should be protected from further contamination by a clean, preferably sterile gauze, dressing and bandage. Further tissue damage should be prevented by the use of a protective splint. With this type of first-aid treatment the patient should be taken to a hospital or dispensary where appropriate and adequate primary treatment can be given to the wound.

Question: What type of skin grafts should be used?

DR. FERGUSON: In the attempt to obtain primary closure of wounds in which there has been a loss of skin, split-thickness or full-thickness skin grafts are the most useful.

Question. What is the value of removing air from closed wounds to prevent hematomas?

DR. REID: I think it is extremely important to remove the air from a wound immediately after it is closed. This can usually be done by the insertion of a clamp between the sutures and the application of gentle, but firm, pressure over the entire area of the wound. This is of especial value in the case of thyroidectomy wounds. It is our feeling that air trapped in the wound predisposes to the collection of serum or the formation of hematomas, which predispose to infection.

Question: Is ether poured in a traumatic wound harmful to the cells?

DR. REID: It most certainly is. In the first place it is not likely to kill all the bacteria and besides it kills or damages many cells which then serve as excellent food for the bacteria left in the wound. The harm of ether and alcohol upon living cells can easily be proved by their effect upon the growth of living cells *in vitro;* by making a fresh open wound on a dog and pouring ether or alcohol into such a wound, one can note its effect on subsequent days.

Question: When should a primarily closed open wound be dressed, and how often?

DR. REID: The answer to this question naturally depends upon the seriousness of the damage beneath the closed wound. In the case of soft-tissue wounds it is our policy not to dress them until it is time to remove some of the sutures, unless the patient complains of pain or develops a fever, which might make the surgeon suspect that the wound has become infected. In the case of wounds in which there is a serious subjacent injury, such as a compound fracture or the opening of a joint, it is our belief that the dressing should be delayed considerably longer, and that the harm of leaving in a few silk skin sutures longer than necessary is more than out-weighed by the value of rest and non-interference to the more important injured structures beneath the closed skin.

Final Remarks by Dr. McClure

It has been a source of great satisfaction to me to listen to the tributes paid to my teachers, the late William Stewart Halsted, and Alexis Carrel, whom we are fortunate to have here with us. We are all familiar with the far-reaching importance of Dr. Carrel's work on wound healing, especially his contributions to the management of war wounds. Dr. Halsted, as you all know, did pioneer work in the handling of surgical wounds. I wish to add my personal tribute to these men because of my long association with both of them.

When one reads the monograph, "The Aseptic Treatment of Wounds," published by Professor Schimmelbusch early in the 1890's, one is filled with amazement at the miraculous saving of life and limb immediately after the realization by the then surgical leaders of the great value of asepsis. Some authorities believe that very little improvement has been made in the treatment of wounds since that time. However, we know that much progress has been made in centers where the principles of asepsis have been strictly applied.

The question now arises as to whether further progress is possible. We believe, as I stated in my opening remarks, that antiseptics would not be so heartily condemned if search were directed toward the discovery of solutions which would be harsh to bacteria but kind to tissue cells. We know that such antiseptics are now being developed and investigated in various laboratories. Proof of their innocuousness is demonstrated by the fact that it is possible for them to be taken by mouth or to be injected intravenously without damage to the tissue cells. Further work must be directed along this line.

Another great advance is suggested in the treatment of gas-bacillus infections. The creation of a high oxygen content in the blood and tissue cells by placing the patient in 100 per cent oxygen atmosphere offers great promise of advancing the treatment of this type of infection.

The thought I wish to leave is that we should not rest on our laurels or feel that further progress cannot be made.

DEEP INFECTIONS OF THE NECK

Collective Review

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INTELLIGENT treatment of deep infections of the neck is founded on not only a broad personal experience in the therapeutic management of these conditions but also a comprehensive knowledge of present-day observations, opinions, and conclusions concerning their nature. A review of the literature may be somewhat confusing since one encounters contradictory statements regarding the course of these infections, conflicting anatomical terms particularly in reference to the cervical fascial planes, and differences of opinion as to the proper surgical treatment. This situation necessarily exists because medical men have approached the problems which arise in the management of infectious processes in the neck from divergent points of view. Then too, so many variable factors influence the course of these infections that principles of treatment are not reducible to definite rules which can be adapted to every case. No doubt, many of our present deductions will be modified and clarified by further research and observation.

This paper consists of a collective review of articles which have appeared in the American and English literature in the past five years and which deal with infections of the neck. Statements made by ourselves are based on a paper entitled "Deep infections of the neck," (20) in which we have analyzed the histories of 267 patients who were treated at The Mayo Clinic for a deep cervical infection.

In general, an infectious process in the neck may exist as a superficial inflammatory lesion (furuncle, carbuncle, erysipelas); as a cervical adenitis, the involved glands of which may break down and undergo abscess formation; or as a cellulitis with or without suppuration. The various types of cervical infection are numerous, and to systematize their study Havens (15) has prepared the following classification: (1) acute suppurative conditions in the neck; (2) woody or ligneous phlegmons (which we consider as characterized by excessive inflammatory induration in which purulent material never develops or does so very late in the disease); (3) infections of a specific nature, including tuberculosis, syphilis, actinomycosis, and tularemia; (4) infected cysts and tumors, such as cystic hygromas, lymphangiomas, and degenerated malignant lymph nodes, and (5) acute suppurative and non-suppurative thyroiditis. In this paper, we are concerned neither with superficial inflammatory lesions nor with specific forms of cervical infection.

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ETIOLOGY

Numerous factors contribute to the development of a cervical abscess or cellulitis. Primarily, such infections consist of the invasion of tissue by pathogenic bacteria. The intensity of inflammatory reaction produced by the presence of these organisms is proportionate to their virulence and to the resistance of the involved tissues.

In the prevention or control of an acute suppurative condition, resistance is an important but inconstant factor. The vitality of the tissues and their inherent ability to withstand infection may be materially diminished in cases of chronic, toxic or destructive disease, as syphilis, nephritis, or diabetes. A great number of authors have reported the association of such diseases with infections; these and similar chronic diseases are significant factors; when present, they are also serious complications.

The sex and age of patients with infections of the neck are of little or no importance. Beck reported that in his 24 cases, approximately 59 per cent of the patients were females and 41 per cent were males. In our group (20) of 267 cases, 59 per cent of the patients were males and 41 per cent were females. As to age, 50 per cent of Beck's patients were infants and children; 50 per cent were adolescents and adults. Boemer said that of his 75 patients with suppurative conditions in the neck, 26 were adults while 49 were children. It is well to consider, however, that of 49 patients who were children 38 had retropharyngeal abscesses, which are particularly prone to occur among children. In our 267 cases, (20) 43 per cent of the patients were under, and 57 per cent were past, the age of twenty years. In these cases the youngest

patient was three days of age; the oldest, seventy-six years.

Deep infections of the neck are invariably secondary to infections elsewhere in the body. Only in rare instances is a cervical abscess or cellulitis primary, as, for instance an infection following a traumatic wound or surgical operation on the neck. Occasionally, a cervical infection is the result of a suppurative process in a distant part of the body, from which the causative organisms are transferred through the blood stream. However, the great majority of the cervical abscesses are secondary to some primary infection of the mouth, ear, nose, or throat. Beck agreed with Mosher, who expressed the opinion that the greatest single cause of these infections is "in or about the tonsils." In 58 per cent of the 24 cases of cervical infection reported by Beck the infection was the result of inflammation of the pharynx or tonsils, in 12 per cent it was the result of dental conditions, and in 29 per cent it was the result of other causes. In 101 of our 267 cases, (20) no cause for the cervical abscess could be ascertained. Analysis of the remaining 166 cases appears to sustain the statement made by Beck, Mosher, and others, that the most common single source of infections of the neck is tonsillitis; 24 of the cervical infections in our series were secondary to tonsillitis and associated pharyngitis. In 110 of the 166 cases the cervical abscesses were the result of the following causes: infections of the mouth or jaws in 55 cases, dental extraction in 21 cases, infected teeth in 13 cases, osteomyelitis of the jaws in 7 cases, fractures of the jaws in 5 cases, gingivitis in 3 cases, stomatitis in 3 cases, infected tumors of the mouth in 2 cases, and an oral operation in 1 case. Cervical infections rather frequently follow tonsillectomy, rhinitis, otitis, and inflammatory lesions of the face and scalp. When the original source of infection is indeterminate, we believe that in most cases there probably has been present in the ear, nose, throat, or mouth a primary infection of such a low grade that it did not give rise to subjective symptoms and could not be detected clinically.

BACTERIOLOGY

Although the type and virulence of the invading bacteria are undoubtedly the most significant etiological factors, probably no phase in the study of deep infections of the neck has received less attention from the majority of clinicians than the bacteriological aspect.

Pearse said the greater number of observers reported that in most of their cases the infection was the result of streptococcic involvement; this coincides with his own findings. Beck and Baker reported that in at least 50 per cent of their cases the infection was caused by the hemolytic streptococcus. Streptococci viridans, staphylococci, and pneumococci were found in some instances, and mixed infections were common.

Bacteriological studies by Alden indicate that many types of organisms are present in a cervical abscess, but in those cases in which the abscess is secondary to oral or dental infection the borrelia vincenti always is the predominating organism. In fact, this anaerobe was found in 24 of Alden's 26 cases, and in 9 it was obtained in pure culture.

Boyne quoted Chatterji and De, who made a study, in India, of cases of cellulitis; they found that the dominant organism was the staphylococcus aureus, which was of sufficient virulence to cause death in 80 per cent of their cases. Boyne also referred to the work of Fabrehart, who recorded that the clostridium welchii is an important organism in the etiology of cervical infections.

In the bacteriological laboratory of Hyde, it was discovered that in the majority of his cases of cervical cellulitis, the organism most frequently encountered was the staphylococcus. However, in his cases of Ludwig's angina, he found a mixed infection of highly pathogenic bacteria with streptococci predominating.

Meleney has made extensive bacteriological studies of the purulent material obtained from cervical abscesses secondary to oral infections. He found that organisms ordinarily found in the mouth, especially non-hemolytic streptococci, could be obtained in most cases; but by studying the material under dark field illumination he found that the fusiformis dentium and the borrelia vincenti could easily be demonstrated. It is of interest to note that the borrelia vincenti was nearly always present in cases in which the condition of the abscess was very severe, but that it often was absent in those cases in which the infection was mild. By the use of special culture media, Meleney was able to grow the organisms, and he found that when the borrelia vincenti was injected into animals in pure culture it was not pathogenic, but when it was injected in combination with other organisms extensive lesions were produced. Meleney's studies indicate that when the infection is essentially due to hemolytic streptococci, a cellulitis without necrosis of the tissues will develop, the fever is high, there is profound intoxication, and the infection is likely to arise and subside rapidly. On the other hand, when the predominating organism is the borrelia vincenti, much necrosis of tissue occurs, the fever

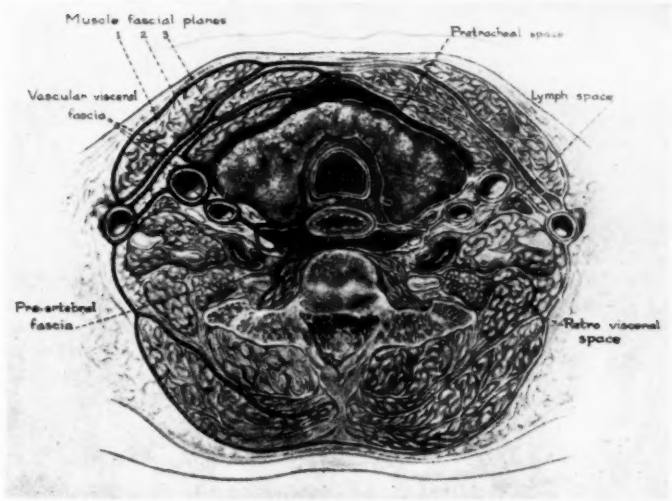

Fig. 1. Horizontal section at the neck showing dissection of the fascial planes and spaces. (Drawing from dissection by Coller, F. A., and Yglesias, Luis: The relation of the spread of infection to fascial planes in the neck and thorax. *Surgery*, 1937, 1: 327.)

and intoxication are less severe than in the cases in which the infection is the result of streptococci, and the infectious process tends to develop and subside slowly.

Summarizing the bacteriological studies that have been recorded, it would appear that many types and strains of organisms will produce a cervical abscess or cellulitis under favorable conditions. Most frequently encountered in such suppurative conditions is the hemolytic streptococcus. In many cases the borrelia vincenti plays a prominent rôle. Only infrequently are such organisms as staphylococci, non-hemolytic streptococci, and pneumococci the primary cause of the inflammatory process, although they occur commonly in the mixed types of infection.

ANATOMY AND FASCIAL PLANES OF THE NECK

A clear conception of the pathology and course of cervical infections necessarily requires an appreciation of the anatomy and fascial planes of the neck. Recent laboratory investigations substantiate well-known clinical observations which suggest that the fascial planes tend to direct and limit the spread of pus in the neck. The cervical fascia consists of fibrous connective tissue which invests the organs of the neck; insheathes the muscles, nerves and vessels; fills the tissue interstices; and binds all of the cervical structures into a working unit. In the words of Alden, "the ramifications of the cervical fascia are such that the neck is divided into a series of planes and potential compartments. By the term 'potential compartments,' I mean certain spaces which, under normal circumstances, are not open, but which, when invaded by an abscess, become true compartments because of the limiting action of the various fascial planes and other structures on their several sides."

Coller and Yglesias, and Furstenberg and Yglesias, in this country, and Barlow, in England, have done some excellent investigative work in demonstrating the cervical and mediastinal fascial compartments. Their conclusions are based on extensive and careful anatomical dissections of the cadaver and on the preparation of large serial sections, together with ingenious injection experiments in which they used opaque, liquid materials to visualize roentgenographically the spread and dissemination of fluids in the tissue spaces of the neck.

Coller and Yglesias divided the fascial planes into two types: those associated with muscles, and those surrounding viscera and vessels. The muscular fascial planes are always inserted into bone, they said, and this limits the spread of infection in these spaces. Since the viscerovascular fascial spaces extend along the viscera and ves-

sels, infection may easily pass from one compartment to another and from the neck into the thorax.

In addition to the prevertebral muscular fascia, Coller and Yglesias described three muscular fascial planes in the neck (Figs. 1 and 2). The first surrounds the neck and encloses the sternomastoid and trapezius muscles. The second encloses the sternohyoid and omohyoid muscles; this plane is attached above to the hyoid bone, below to the sternum, and continues laterally around the neck between the trapezius and the deep vertebral muscles to be inserted into the ligamentum nuchæ. The third plane encloses the sternothyroid and the thyrohyoid muscles; above it is attached to the hyoid bone, below it is inserted into the manubrium, and laterally it fuses with the sheath of the internal jugular vein. Beneath these three musculofascial planes and anterior to the prevertebral muscular fascia lies the visceral vascular space with its own system of fascia, which leads directly into the thoracic cavity.

From a general anatomical point of view, Barlow has visualized the neck as being composed of four units, namely, the vaginal, vertebral, visceral, and "great vessel."

The vaginal unit consists of the sternomastoid and trapezius muscles and the vaginal fascia (usually referred to as the superficial layer of the deep fascia), which splits to enclose these muscles. Barlow fancied this unit to be a musculofascial tube that encloses all of the other structures of the neck. Posteriorly, the vaginal fascia fuses with the prevertebral fascia, and anteriorly it is attached to the hyoid bone. In the suprasternal notch, this fascial layer splits to form a fat-filled pocket termed the "space of Burns." In its upward course, the vaginal fascia is fixed to the inferior border of the mandible; passes under the lower edge of the parotid gland to form the stylomandibular ligament; then proceeds upward, external to the parotid gland, to the zygomatic arch where, Barlow said, it has a loose attachment; and continues on upward to the temporal ridge. From the stylomandibular ligament, the vaginal fascia sends a thin fascial membrane to cover the mesial aspect of the parotid gland.

The vertebral unit is composed of the cervical vertebræ and associated muscles and the investing pretracheal fascia. Posteriorly, the fascia of the vertebral and vaginal units fuse; anteriorly and inferiorly, the prevertebral fascia fuses with the fascia about the subclavian vessels to roof in the pleural apex.

The visceral unit includes all of the cervical structures except the great vessels, which are situated between the vertebral unit posteriorly and the vaginal unit anteriorly and laterally. It is interesting to note that Barlow included the suprahyoid and infrahyoid muscles among the structures of the visceral unit, because they undergo longitudinal movements, which, he insisted, are essential to the visceral structures during deglutition. Barlow visualized the vaginal unit as forming a sort of investment, comparable to a tendon sheath, for the visceral structures which act as a tendon and move up and down within the sheath.

Barlow referred to the ramifications of fascia which surround the visceral structures and form potential compartments as "fascial condensations." Above, there occur bilaterally three such fascial compartments worthy of much consideration. They are the submaxillary, parotid, and lateral pharyngeal (pharyngomaxillary) spaces.

The submaxillary space lies between the visceral fascia which covers the mylohyoid muscle and the overlying vaginal fascia. Contained within this space is the submaxillary salivary gland, which Barlow said has its own fascial condensation in the form of a capsule.

The parotid space is formed by the vaginal fascia, which is separated from the submaxillary space by the stylomandibular ligament, and from the lateral pharyngeal fossa by the thin membranous off-shoot of vaginal fascia from the stylomandibular ligament. Within the parotid space lie the parotid gland and the parotid lymph nodes.

The lateral pharyngeal space is a fat-filled pyramidal-shaped compartment, 1½ in. (3.7 cm.) in vertical length. Its base is situated at the base of the skull, and its apex, at the greater cornu of the hyoid bone. As described by Barlow, it is bounded laterally by the parotid space and fascia; anteriorly, by the internal pterygoid muscle and the ascending ramus of the mandible; mesially, by the superior constrictor muscle of the pharynx which separates this space from the tonsil; and posteriorly, by the stylopharyngeus aponeurosis, which covers the great vessels and which Barlow claimed is a strong barrier against the passage of infection between the lateral pharyngeal space and the great vessels. A direct communication exists between the lateral pharyngeal and the submaxillary spaces, but no communication is to be found between either of these spaces and the parotid compartment. However, the mesial-limiting membrane of the parotid space is a rather poor obstacle to the dissemination of pus from the parotid space into the lateral pharyngeal space.

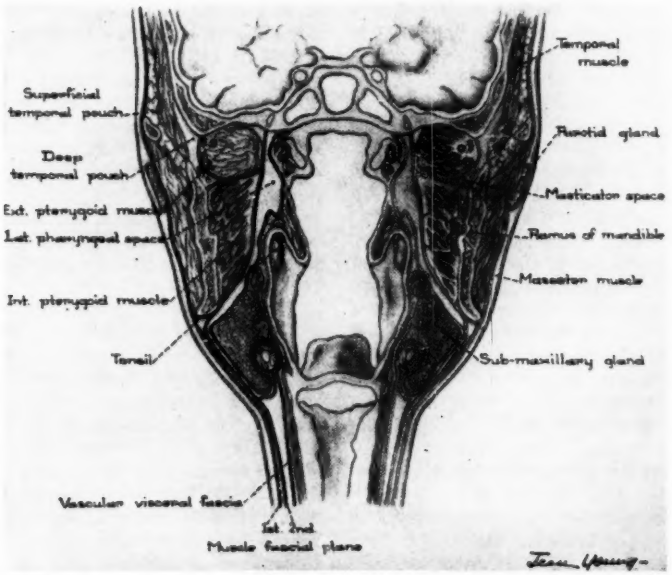

Fig. 2. Frontal section demonstrating the different fascial planes and potential anatomical spaces. (Coller, F. A., and Yglesias, Luis: Infections of the lip and face. *Surg., Gynec. and Obst.*, 1935, 60: 277.)

Barlow referred to the visceral compartment between the prevertebral fascia, posteriorly, and the pharynx and esophagus, anteriorly, as the retrovisceral (also termed pretracheal and retropharyngeal) space. He claimed that this space is bounded laterally by condensations of fascia which run parallel with and ¾ in. (1.8 cm.) from the median line. Coller and Yglesias said that the retrovisceral space is continuous from the base of the skull to the diaphragm, although it may be partially or completely occluded at the level of the bifurcation of the trachea.

According to Barlow, fascial condensations surround the pharynx, esophagus, larynx, trachea, and thyroid gland. The upper portions of these condensations are referred to by Ford, Dorrance, and others as the "bucco-pharyngeal fascia." Coller and Yglesias said that the fascia surrounding the pharynx, esophagus, larynx, trachea, and thyroid gland forms a sort of compartment, which they termed the "pretracheal space"; this space, they said, ends below in the fibrous pericardium and encloses the aorta and its branches.

On either side of the median line and beneath the vaginal fascia and the infrahyoid muscles are two fascial compartments, which Barlow has named the "subvaginal spaces," and which contain the deep cervical lymph nodes. Coller and Yglesias said that these spaces are triangular in outline, the base lying in the supraclavicular fossa and the apex extending up to the mastoid process of the temporal bone.

The "great vessel" unit consists of the fascia commonly known as the carotid sheath, and the carotid artery and the jugular vein. Anatomical studies by Barlow disclosed that the artery and vein each have a separate compartment in the fascial covering. He termed these compartments the "carotid" and "jugular" sheaths. The "great vessel" unit possesses no longitudinal mobility, but since its branches enter the mobile visceral unit, these branches run a very tortuous course. According to Scheldrup, there exists a bridge of fascia between the visceral fascia surrounding the respiratory and digestive tracts, and the vascular sheaths, and he termed this bridge the "alar" fascia. Alden made the statement that the carotid sheath emerges from the apex of the lateral pharyngeal space and, for all practical purposes, is a continuation of this fossa through the neck into the thorax. Beck considered the submaxillary, lateral pharyngeal, and parotid spaces to be in more or less direct communication with the carotid sheath; he compared these three spaces to

the leaves of a trifolium with the carotid sheath as the stem. However, the injection experiments of Barlow failed to show that the carotid sheath has any connection at all with these three fossæ.

According to Furstenberg and Yglesias, the thorax may be divided into three potential fascial spaces.

The first thoracic space lies in the retrosternal region. This space need not be considered in infections of the neck because it has no communication with fascial spaces in the neck.

The second thoracic space is a continuation of the pretracheal fascial space of the neck into the thorax. This pretracheal space communicates directly with that part of the mediastinum which lies between the arch of the aorta in front, and the trachea posteriorly.

The third thoracic space is a direct communication of the retrovisceral space of the neck into the thorax. There is here a direct communication of a cervical fascial space with the posterior mediastinum.

Injection experiments, which are designed to show the spread of pus from one fascial compartment to another in the neck, are of interest. However, it is well to keep in mind Barlow's statement, "no injection technique can be strictly comparable to the spreading of pus in an active inflammatory process." The results of Barlow's injection experiments will be described in the following paragraphs.

Upon the injection of fluid into the lateral pharyngeal space, it was found difficult to make the fluid burst into the submaxillary or parotid spaces. When fluid was injected into the submaxillary space, however, it readily escaped into the lateral pharyngeal space. When fluid was injected into the parotid space, it extended upward toward the temporal region; only when the fluid was injected under considerable pressure did it enter the lateral pharyngeal space. In no case did the fluid enter the carotid sheath after it had been injected into the submaxillary, lateral pharyngeal, or parotid spaces.

Fluid entering the retrovisceral space from above did not pass downward easily into the posterior mediastinum below the level of the third thoracic vertebra. Only when considerable pressure was used did the fluid penetrate into the subvaginal space.

The injection of fluid into the space of Burns revealed that as the pressure was increased the fluid entered the subcutaneous tissues.

The injection of fluid into the subvaginal spaces disclosed that the fluid did not cross the median line; did not enter the parotid, lateral pharyngeal, or submaxillary spaces; and did not enter the jugular sheath; in only 1 case was there any sign of leakage into the thorax.

In reviewing all of Barlow's injection experiments, one discovers that the injected fluid entered the mediastinum but rarely, and then with difficulty, and that in no case did the fluid in the cervical fascial spaces find entrance into the jugular sheath.

The clinical value of the foregoing discussion on the cervical fascial planes will be given consideration in the following section of this paper.

PATHOLOGY

The majority of infections of the neck probably are the outcome of a cervical adenitis, which, in turn, excepting in those cases in which the infection is of hematogenous origin, is the result of drainage of infectious material from the primary lesion through the lymphatics. A cervical cellulitis represents a direct extension of the primary infection through the loose, cellular tissues of the neck. Because the pharynx and oral cavity are frequently the primary source of infection, it is reasonable to assume that the upper cervical regions and fascial compartments would be the most frequent sites of an infectious process. This we have found to be true, since in 166 or 66 per cent of our 267 cases the infection involved the submental, submaxillary, and upper cervical regions. In association with the study of the fascial planes, much has been written on the relation of the limiting action of these planes to the spread of infection in the neck. Dorrance said, "surgeons as a whole agree with Havens that 'pus does not burrow along the fascial planes as frequently as anatomists would have one believe.'" No doubt, the cervical fascial planes do tend to direct the spread of infection, but there are also other factors which are concerned with the course of an infectious process in the neck. Pus is not an inert fluid which flows like water from one fascial space to another. On the contrary, pus is an exceptionally active material that invokes many types of defensive reactions on the part of the involved tissues. Just as any other abscess in the body of an otherwise healthy person, a cervical abscess tends to become walled off in response to the inflammatory reaction. In our experience, the digestive enzymes produced in the purulent material tend to disintegrate the overlying tissues so that the abscess points to the surface. Although in some cases pus may burrow along the fascial planes, this is not the usual course of events. It is interesting to read Ford's description of the parotid fascia in which he said that "one is impressed by

the great tensile strength of the deep cervical fascia,—a sheath of fibrous tissue as tough as a whip-cord,—the dense parotid fascia with the trabeculæ knitting the gland together like a Persian rug,—capable of sustaining a weight of two or three hundred pounds. This forced the realization that fluctuation in the neck at a sensible time is an impossible thing. Pus will not work through a 'cow hide' so to speak." Regardless of the strength of the parotid fascia, time and time again we have seen a parotid abscess break through the dense parotid fascia and drain through a sinus in the skin rather than penetrate mesially into the lateral pharyngeal space. Again, many authors speak of the dangers of pus in the cervical region draining into the mediastinum. Yet, a case in which mediastinitis was secondary to a cervical infection has never been seen among our patients at The Mayo Clinic (20) and, furthermore, few such cases have ever been reported in the literature. However, no matter how remote the development of mediastinitis may be, these findings neither preclude the possibility of mediastinitis developing in the presence of a cervical infection, nor belittle the seriousness of the complication.

The submaxillary triangle is one of the regions of the neck most frequently involved by infection. Infection of the submaxillary space may exist as a cellulitis, an adenitis, or an infection of the submaxillary salivary gland with secondary implication of the submaxillary fascial compartment. Much confusion has arisen concerning the distinction between the terms "infection of the submaxillary fascia" and "Ludwig's angina." Beck and others have referred to all infections in the submaxillary region as Ludwig's angina. Vickers used this term to denote a group of infections which may extend from the mucous membranes deeply along the lymphoid tissues of the pharynx and produce a diffuse swelling and hypertrophy of all the lymphoid and areolar tissues of the neck with explosive suddenness. According to Colp, Ludwig's angina "has been made to include almost every infectious process in the mouth and neck, especially if it terminates fatally." Most observers, we believe, agree that Ludwig's angina refers to a cellulitis of the loose, areolar tissues of the floor of the mouth, and that the process may secondarily involve the submaxillary fascial space.

Incidentally much discussion has taken place as to whether or not the term "Ludwig's angina" is a suitable name for the condition that it signifies. Colp said that the term is incorrect since Gensoul of Lyons, in 1830, was the first to describe this condition. Pearse agreed with Thomas, who expressed the opinion that the term may be a misnomer but that "the time has not yet arrived when we can conveniently discard it."

Ford emphasized the fact that Ludwig's angina is a celiulitis and not a lymphangitis. This inflammatory process, according to Colp, is an active diffuse phlegmon, resembling a rapidly spreading cellulitis in which pus is unusual. Barnhill stressed dental infections and dental operations as the chief causes of this condition. The suppurative material from a dental root, said Dorrance, may follow the mandibular canal and find exit at the inferior dental foramen; it then passes down the mylohyoid groove beneath the periosteum to the sublingual tissues. When once infected, the loose areolar tissue of the floor of the mouth, Barnhill declared, does not offer the slightest resistance to the spread of the infection.

Beck divided infections of the submaxillary space into two groups: those of dental origin and those due to various other causes. Infected lower first and second molar teeth, Alden claimed, are the most frequent sources of infection of the submaxillary fascia. Pus in this region need not necessarily involve the submaxillary gland, according to Barlow, because the gland is protected by its own capsule of connective tissue. As recorded by Beck, Barlow, Dorrance, and others, the infection may not remain confined to the submaxillary compartment since it can easily enter the lateral pharyngeal space.

Infection of the lateral pharyngeal space is common, and on the authority of Ford, involvement of this space occurs in more than half of the cases of deep infections of the neck. Of Beck's 24 cases, the lateral pharyngeal space was involved in 58 per cent. He said that the primary source of infection in this region may be in the nose, paranaşal sinuses, adenoids, pharyngeal lymph nodes, cervical vertebræ, mastoid cells, and the petrous portion of the temporal bone. Occasionally, infection of the submaxillary or parotid space may infect the lateral pharyngeal compartment. However, the most common source of infection is the tonsils. Beck quoted Waldapfel, who showed that infection of the tonsils or pharynx may penetrate the constrictor muscle of the pharynx and may, by direct extension along the veins, involve the lateral pharyngeal space. Very often this fascial compartment is infected following tonsillectomy under local anesthesia. Referring to the work of Shapiro, who has reported 103 cases in which pharyngomaxillary infection followed tonsillectomy, Barnhill asserted that the infection is due to direct contamination of the region because the needle used for the in-

jection of the solution of procaine is thrust through the infected tonsil into the lateral pharyngeal space. Ford, who used Shapiro's classification, said that infection of this fascial compartment may be of a phlegmonous type, in which there are few if any local symptoms, but in which there are evident signs of thrombophlebitis due to involvement of the internal jugular vein. Many clinicians consider involvement of the jugular vein associated with infection of the lateral pharyngeal space to be due to direct extension of the inflammatory process. However, Barlow, and Hicken and Popma claimed that since this space is separated from the carotid sheath by the stylopharyngeal aponeurosis, infection may reach the jugular vein only by way of the smaller veins, not by direct extension.

Parotitis and infection of the parotid space may be hematogenous in origin, but, as Vickers and Dorrance have affirmed, in most cases of septic parotitis the patients are persons who have had abdominal operations and cannot or do not take fluids by mouth for a few days. This results in a dry mouth, which, in turn, permits organisms to flourish in the oral cavity; in time, these bacteria work their way back through the parotid duct to infect the gland. Infections of the parotid space may penetrate the thin mesial fascial wall and infect the lateral pharyngeal fossa.

Seventy-five per cent of infections of the retropharyngeal (retrovisceral, pretracheal) space occur during the first three years of life, asserts Ford, and generally follow some debilitating disease in connection with an infection of the upper part of the respiratory tract. The explanation of this statement, as made by Barnhill, lies in the fact that the retropharyngeal lymph nodes are particularly well developed in children, but disappear or become atrophied in adult life. Richards reported a mortality of 7.4 per cent in cases of retropharyngeal abscess. As has been previously described, the retrovisceral space extends from the base of the skull to the diaphragm and is usually partially or entirely occluded at the level of the bifurcation of the trachea. Coller and Yglesias said that infections of the retrovisceral space below this constriction are always secondary to lesions of the vertebræ and ribs, or to perforation of the esophagus below this level. Infections above the constricted zone are secondary to infections of the ears, nose, or throat, or to infections of the cervical or upper thoracic vertebræ, the basilar process of the skull, the petrosal bone, or to perforation of the esophagus.

A retropharyngeal abscess may not remain confined to the upper portion of the retrovisceral space, but may gravitate downward, produce edema of the larynx, and sometimes rupture into the esophagus or trachea. Beck said that a retropharyngeal abscess may endanger the lateral pharyngeal space when it extends laterally. Injection experiments have led Barlow to believe that suppurative conditions in this region may enter the subvaginal spaces below the level of the hyoid bone where the lateral boundaries of the retrovisceral space are less strong. Baker said that a true infection of the median part of the retrovisceral space will extend into the posterior mediastinum.

Infection of the pretracheal fascial space is not common. Coller and Yglesias expressed the opinion that such infections are generally the result of infection of the lateral pharyngeal space, of an inflammatory process in the lateral wall of the pharynx, or of a perforation of the esophagus. Although rare, thyroiditis may cause infection of the pretracheal space.

Suppurative conditions in the subvaginal spaces are common in connection with cervical adenitis, and many authors believe that these spaces may become infected by purulent material from other fascial compartments.

Pere has never seen a carotid sheath filled with pus, but has encountered infection gravitating down mesially and anteriorly to the vessels. He expressed the opinion that the pus burrows along the loose areolar tissue beside the vessels rather than runs down within their sheaths. As stated by Barnhill, the carotid sheath may be infected from broken-down infected lymph nodes, from perforation of the esophagus, or from the accumulation of pus in any one of the fascial spaces. Barlow, by experimentation, has found that phlebitis of the jugular vein is the result, not of direct extension of a suppurative process into the jugular sheath, but of the transmission of purulent material along the sheaths of some of the smaller venous branches to the jugular vein.

SYMPTOMS

Infections of the neck are generally marked by an insidious onset of symptoms. Soon to appear are signs of toxemia which progressively increase in severity. The temperature, which is only slightly elevated at the beginning of the process, rises day by day until a peak is reached, after which it gradually falls. Chills and sweats may accompany these symptoms. Locally, a brawny indurated region of inflammation is noticed at first. Swelling, redness, and pain gradually become more marked until fluctuation of the involved region is finally evident. In some in-

stances the infectious process may run a very rapid course and fluctuation may appear in four or five days. However, in other cases the infection may be very indolent, with board-like infiltration, and a month or two, or even a longer time, may elapse before signs of suppuration can be noted. In our (20) series of 267 cases, the average time between onset of infection and the period at which fluctuation occurred was about three weeks.

When a cervical abscess lies near or adjacent to the upper part of the digestive or respiratory tract, sufficient edema may occur to make deglutition difficult if not impossible. Respiration is labored, and in an occasional case the dyspnea may be severe enough to necessitate tracheotomy.

Symptoms produced by involvement of the submaxillary, lateral pharyngeal, parotid, retropharyngeal, pretracheal, and subvaginal spaces, and of the carotid sheath require special consideration.

Cellulitis involving the submaxillary region is to be distinguished from Ludwig's angina. Most observers agree that Ludwig's angina runs a much more rapid course than infection of the submaxillary space. In reference to the former condition, Dorrance said that "in less than eight to ten hours a comparatively minor swelling of the neck becomes a serious surgical problem with a grave outlook." Colp said that before the submaxillary triangle actually becomes involved in Ludwig's angina characteristic objective signs may be noted. There is present a stony hard swelling in the submaxillary region; the overlying skin is edematous but not reddened; and fluctuation is usually absent. In the floor of the mouth, edematous swelling and induration are apparent. Partial trismus may be encountered, and the tongue is elevated and motionless. If the abscess in Ludwig's angina, according to Barnhill, is confined to one side, the tongue is pushed over to the opposite side; if the condition is bilateral, the tongue will be crowded against the roof of the mouth and back over the glottis so as to produce marked respiratory embarrassment in some cases. Barnhill quoted Blassingame, who said that "the floor of the mouth is so greatly swollen as to give the appearance of a second tongue."

Hyde has made some very careful observations concerning the differential diagnosis of Ludwig's angina and cellulitis of the submaxillary space. He said that a true Ludwig's angina presents an evenly colored skin over the diffuse swelling which is painful to touch over its entirety. However, in cases of infection of the submaxillary space the overlying skin is reddened and there is usually one point of extreme tenderness. When submaxillary cellulitis is incised much pus is obtained; in true Ludwig's angina pus formation is rare.

It was Beck's opinion that in cases in which infection of the submaxillary space is of dental origin, the prognosis is good and the infection yields promptly to submaxillary drainage, but in those cases in which the infection is not of dental origin the condition is insidious and dangerous.

The cardinal symptoms of infection of the lateral pharyngeal space, as affirmed by Beck, are trismus, swelling over the parotid gland, and displacement of the tonsil and palatal arch on the affected side to the median line. The uvula may point almost horizontally, he said, to the opposite side. There is no enlargement of the tonsil itself unless it too is involved in the inflammatory process. This point is of diagnostic value in the differentiation of a paratonsillar abscess from an infection of the lateral pharyngeal space.

Barnhill said that external fluctuation at the angle of the jaw seldom is present in cases of infection of the lateral pharyngeal space. He expressed the opinion that infections in the fascial compartment have a greater tendency to descend downward around the carotid sheath than to point to the surface.

The local signs and symptoms of infection of the parotid space are well known. Pressure on the gland may express purulent material through the parotid duct into the mouth. This is often of diagnostic significance.

As outlined by Coller and Yglesias, infections of the retrovisceral space produce dysphagia, dyspnea, and dysphonia. A bulging pharyngeal wall can be noted, and fluctuation may be present. Roentgenological examination will show an increase in the width of the retrovisceral space in both the anteroposterior and lateral projections. These authors said that among children the chief symptom is dyspnea. Barnhill warned against palpation of retropharyngeal abscess in infants and children, since the examining finger may split the soft palate, or may rupture the abscess and cause danger of suffocation.

Torticollis may arise from infections in the subvaginal space or from infections about the carotid sheath. Black declared that torticollis resulting from infection under the sternomastoid muscle is toward the opposite side, and that resulting from infection along the paravertebral and trapezius muscles is toward the same side.

In reference to infections of the carotid and jugular sheaths, many authors claim that tenderness along the course of the carotid and jugular vessels is of importance, but Beck said that one should not be guided by the presence or absence

of local signs in diagnosing infection of the jugular sheath. Rather, one should rely on the degree of sepsis. He further emphasized the fact that phlebitis of the jugular vein can take place early in the course of a cervical infection.

TREATMENT

With regard to the treatment of deep infections of the neck, there are two schools of thought, each of which claims satisfactory results.

There is one group of surgeons who advocate radical surgical procedures early in the course of these infections. It is their conviction that wide anatomical dissections are necessary to gain sufficient exposure of the infected fascial compartment; then, by the establishment of adequate drainage, the infection is prevented from spreading into other visceral and vascular fascial spaces. The ultimate result, these men believe, is the reduction of complications to a minimum.

Another group of surgeons favor very conservative methods of management. The essence of their treatment of cervical infections is the delay of drainage until fluctuation can be detected, or until the process is well localized. To incise an inflammatory process before it has become walled off, they are convinced, not only exposes healthy tissues to infection but also invites secondary invasion by pathogenic organisms from the outside. It is their conclusion that complications are more likely to occur if radical measures are instituted than if conservative methods are employed.

The important consideration in the radical treatment of infections of the neck is the anatomical approach for drainage of the numerous fascial compartments and planes.

For drainage of the submaxillary and the lateral pharyngeal spaces, Coller and Yglesias recommended a long straight skin incision, 1.5 cm. below the lower border of the mandible, while Beck favored Mosher's T-shaped incision. Either of these incisions will give adequate exposure for exploration of the submaxillary space. They also allow for palpation of the lateral pharyngeal fossa; by inserting the index finger up under the submaxillary gland and then thrusting it through the natural opening into the lateral pharyngeal space, one is able to make a digital examination of all the structures associated with this compartment. After the skin incision has been made, blunt dissection is advocated by most surgeons.

Suppurative processes, not of dental origin, in the submaxillary space require early drainage according to Beck. If either the submaxillary triangle or the lateral pharyngeal space is involved by infection, Colp declared that the submaxillary gland must be removed in order to obtain free drainage. However, most observers do not agree with Colp on this point. In some cases of infection of the lateral pharyngeal space in which there is present a definite region of pointing into the pharynx and in which suppuration is suspected, Ford advised incision directly behind the posterior tonsillar pillar and an attempt to find the pus by the use of a blunt instrument; should this procedure fail, the external approach is used.

Much has been written about inflammatory involvement of the jugular vein in cases of infection of the lateral pharyngeal fascia. Ford quoted Shapiro as stating that a chill followed by a sharp rise in temperature during the course of an infection of the lateral pharyngeal fascia should be regarded with suspicion, and said that repetition of these symptoms within twenty-four hours calls for exposure of the jugular vein. Through either of the incisions described previously, one can obtain an excellent exposure of the vein within or below the lateral pharyngeal fossa.

If the abscess in cases of Ludwig's angina lies above the mylohyoid muscle, Ford recommended evacuation by an incision in the floor of the mouth; if it is below this muscle, he recommended a deep external incision. Colp said that the old empirical median-line incision in the submental region must be discarded as the infection is practically never situated in the median line. For exposure of the tissues in the floor of the mouth, he advocated the use of local anesthesia, and advised the use of a lateral incision in the submaxillary region, the cut being made upward and across the fibers of the mylohyoid muscle to avoid a cut across important structures in the floor of the oral cavity. When the submaxillary space is involved in Ludwig's angina, Pearse said that the success of surgical treatment rests on the release of pressure in this fascial compartment, and Colp insisted that the submaxillary gland must be removed to allow for free drainage.

Involvement of the pretracheal space secondary to hypopharyngeal infections, according to Beck, can be drained within the throat, provided that care is taken not to injure the superior laryngeal nerve when the incision in the piriform fossa is made. If internal drainage does not check the progress of the infection, external drainage is indicated. Coller and Yglesias said that drainage of the pretracheal space is best carried out through an incision along the anterior border of the sternomastoid muscle at any desired level between the hyoid bone and the sternum. The incision being carried through the three anterior muscular fascial planes, the thyroid gland is

exposed and lifted aside after incision of its fascia; then deeper, the pretracheal fascia is encountered and on incision the pretracheal space is laid open.

Most surgeons agree with Beck that in cases of retropharyngeal abscess without respiratory embarrassment simple peroral incision for drainage is usually effective. If severe dyspnea develops, tracheotomy may be necessary. In some cases of retropharyngeal abscess a pharyngeal incision will not give adequate drainage; in such cases, Scheldrup advised an external approach to the retrovisceral space. He used a skin incision along the anterior border of the sternomastoid muscle, and exposed and retracted the great vascular sheath laterally. This puts the alar fascia (fascia between the carotid sheath and the pretracheal fascia) on the stretch; a blunt instrument passed through this fascia enters the retrovisceral space without injuring the vessels or nerves. Moreover, this approach makes finger exploration of the retrovisceral compartment possible for a considerable distance superiorly and inferiorly.

For infections of the carotid and jugular sheaths, many methods of approach have been advocated. Scheldrup has prepared an excellent detailed account of the incisions and dissections necessary for access to the carotid artery and jugular vein at various levels in the neck.

Many surgeons, who stress the necessity of radical measures and of early operation in the treatment of infections of the neck, are very emphatic in their disapproval of conservative management. Beck said that if the deep lymph nodes are involved by infection, extension is to be expected and the compartments invaded must be drained. He said further that delayed operation is liable to be disastrous and engender regret. According to Colp, the mortality rate in Ludwig's angina and infections of the submaxillary space is 40 per cent, because operation is instituted too late or drainage is inadequate. Boyne believes that neck infections regardless of the part involved, must be considered potentially fatal.

Surgeons who favor conservative types of treatment cannot agree with these statements. In our group of 267 cases, conservative treatment was employed with very satisfactory results. In fact, there were but 8 deaths in the entire group, and in only 2 cases, 0.07 per cent, could death be attributed to the cervical infection. Our method of treatment (20) is as follows:

"Patients who have cervical infections are put to bed and large hot, moist dressings, which are changed hourly, are applied over the involved region. If inflammatory edema of the mouth or throat is present, hot irrigations are used. When a patient has great difficulty in swallowing or is unable to do so, a Rehfuss feeding tube is inserted through the nose into the stomach so that sufficient intake of fluid can be maintained.

"If edema of the hypopharynx or larynx is present, but is not of sufficient magnitude to cause severe dyspnea, steam and an oxygen tent are helpful. However, when dyspnea is pronounced, no time is lost in opening the trachea. In performing tracheotomy, if it is necessary to open the infected region in order to reach the trachea, the wound is packed and maintained widely open with iodoform gauze. Six of our cases required tracheotomy, five of which were reported by one of us (New) (19).

"Drainage of the abscess should not be undertaken before fluctuation is present or the abscess localized. If the abscess is situated deep in the neck, it is frequently difficult to detect fluctuation, and under such circumstances, the opportune time for drainage must be governed by the general symptoms, duration of the phlegmon and a conviction on the part of the surgeon that pus is present deep in the neck. Frequently, deep fluctuation may be present beneath the sternocleidomastoid muscle or deep in the submaxillary region. Preferably drainage is carried out among adolescents, older children and adults, under intravenous anesthesia using pentothal sodium; among infants and young children, gas anesthesia is safer than intravenous anesthesia. However, at any age, if there is any obstruction to the respiratory tract, the patient should never be put to sleep, for fear of inducing complete obstruction. In such cases, a spray of ethyl chloride is used as a local anesthetic. A small incision is made through the skin overlying the fluctuant region, and through this incision, a curved hemostat is thrust into the abscess. On no occasion has severe bleeding occurred at the time of drainage owing to opening into a large blood vessel. After evacuation of the pus, a drain consisting of a fairly stiff rubber tube is inserted and is retained in position by sutures. Occasionally, in dealing with large cavities, the wound is packed lightly with iodoform gauze which is left in place for twenty-four to forty-eight hours. The drain is not removed until seven to ten days after insertion.

"At the time of drainage, it should be kept in mind that the infectious process may be actinomycotic or tuberculous in nature. The yellow sulfur bodies so diagnostic of actinomycosis should be searched for carefully throughout the purulent material. The caseous material and granulations found in tuberculous abscesses are well known."

We believe that a woody phlegmon, in which pus does not form, should never be incised, even though it requires months to subside or to undergo suppuration. Hot dressings and roentgen therapy are useful aids in the treatment.

In the conservative management of deep infections of the neck, the fascial planes really are of little importance. Although they should tend to determine the primary situation of the infection in the neck, the barrier produced by the wall of the abscess is of considerably more importance than the fascial compartments and planes.

Hicken and Popma favored a conservative form of treatment for cervical infections and said that the therapeutic errors in the local management of suppurative adenitis are not those of omission but rather of commission; too early and inadequate drainage are two important mistakes.

In the conservative treatment of infection of the parotid space or parotitis, Vickers said that the best treatment is prophylaxis by the use of chewing gum, especially in cases in which the infection is secondary to operations on the stomach or peritoneum. This stimulates the flow of saliva and decreases the likelihood of gland infection.

As reported by Roehm, Boyne, and Dorrance, irradiation has proved its value in the treatment of many deep infections of the neck, especially parotitis, cellulitis, and adenitis. Irradiation in the early stages allows many infections to subside without suppuration (Dorrance).

Because bacteriological studies have proved that the borrelia vincenti is frequently an offending organism in cervical infections secondary to diseases of the mouth, Alden and Boyne have administered neoarsphenamine as a therapeutic measure with much success. They said that in some cases the inflammatory mass subsides entirely without further treatment. Alden has even adopted the practice of giving neoarsphenamine in the treatment of all types of cervical infections whether or not borrelia vincenti can be demonstrated. Boyne said that at times the results seem almost miraculous, and he was certain that a number of his patients were saved from external drainage by the use of this drug.

In cases of infection in which the tissues have been opened by adequate operation, Meleney declared that the infection can be brought under control by careful application of zinc peroxide suspended in sterile distilled water. If this is done, he said that the foul odor will almost immediately disappear and smears and cultures of the exudate will show rapidly decreasing numbers of fusiform bacilli, Vincent's spirochetes, and anaerobic streptococci.

COMPLICATIONS

By employing a conservative type of treatment, we have witnessed very few complications in deep infections. Erysipelas occurred in 4 of our (20) cases but disappeared after irradiation.

A possible complication is hemorrhage due to sloughing in the wound with involvement of larger blood vessel. Barnhill reported a case in which fatal hemorrhage was due to erosion of a large vessel, and Alden observed cases in which the external maxillary artery was involved.

Perhaps, among all the cervical infections, hemorrhage is never more serious than in a case of retropharyngeal abscess. Havens quoted Lifschutz, who collected reports of 23 cases in which hemorrhage was secondary to retropharyngeal abscess; in this series there were 19 deaths. The diagnosis of retropharyngeal hemorrhage may be difficult because the bleeding may be into the cavity of an unruptured abscess. According to Havens (14), "enlargement of a retropharyngeal mass in a few hours is significant. It may mean erosion of a large vessel although no blood is appearing on the surface. If such a condition is suspected, aspiration before incision would be wise." In the words of Ford, "The slightest sign of hemorrhage in the presence of a retropharyngeal abscess is an indication of danger and calls for immediate action, as it may be followed at any moment by a sudden fatal hemorrhage. In such event packing and pressure have little effect and ligation of the internal or common carotid is the only alternative." Some surgeons may hesitate to ligate the internal or common carotid artery for this condition, but Havens said that "most patients who require this procedure are young children and the risk of circulatory complications secondary to ligation is slight in comparison to the danger of fatal hemorrhage without it."

Probably no complication of cervical infection has received as much attention as jugular thrombosis, and, without question, it is a serious complication. However, with the use of conservative methods of treatment of deep infections of the neck, we believe that thrombophlebitis of the jugular vein is uncommon. In our (20) entire series of 267 cases, we observed but 1 case of jugular thrombosis. Chase has made a thorough review of the literature on this important subject. Many men are of the opinion that infection in any of the fascial spaces may lead to jugular thrombosis. As far as the pathological changes of venous thrombosis are concerned, Chase said that there is first a local infective process which is complicated by an infection of the veins returning from that region, which tends to extend along

the vessels, from the smaller to the larger, in any direction and does not tend to become localized. The results of thrombophlebitis of the jugular vein, according to Chase, are further extension of the infective process into the surrounding regions that normally would escape infection, and a general infection of the blood stream, with septic infarcts scattered throughout the body. He said that in these cases the patients often give a history of having been subjected to repeated incisions for drainage of the localized abscess, no pus being obtained, or a local abscess may have been freely evacuated without relief of the septic symptoms. The diagnosis rests upon the presence of an inflammatory process extending along the large venous channels of the neck and upon definite embolic symptoms associated with a picture of grave general sepsis. According to Beck, chills, sweats, and high temperature are common symptoms and do not necessarily require jugular resection unless they continue some days after adequate drainage has been established; however, they demand immediate drainage of the fascial compartments. When the patient shows signs of much sepsis, blood cultures should be made early in the course of the disease, because of the possibility that negative results will be obtained after the vein is blocked by the thrombosis. Beck said also that blood cultures are most likely to be positive if the blood is taken during or immediately after a chill. One should not rely on the external signs in diagnosing jugular thrombosis, but should depend on the degree of sepsis. In reference to the prognosis of phlebitis of the jugular vein, Chase said that if the condition remains unrecognized and untreated, it is fatal in nearly 100 per cent of the cases. He places the mortality rate at 50 per cent in all cases in which the open method is used and said that infective phlebitis always presents a higher mortality than infective thrombophlebitis. In treating phlebitis of the jugular vein, it is generally recommended that the infected vein be ligated; thrombosed portions should be resected.

Many men have considered the danger of mediastinitis as a complication of cervical infections. However, very few instances of this complication have been reported, and, as previously stated, the complication has not been seen at the clinic. In the majority of cases of mediastinitis reported, the condition involved the retrovisceral space and was due to perforation of the esophagus by a foreign body that had lodged in the gullet, or by a stab or gun-shot wound. As stated by Black, the symptoms in these cases are extreme dysphagia, pain, and fever, followed by swelling and tenderness at the base of the neck. If there has been a perforation of the esophagus, initial emphysema at the base of the neck may be present. Pearse said that should one suspect an esophageal fistula, and the patient is given a small amount of methylthionine chloride (methylene blue) to swallow, the appearance of the dye on the dressings of the neck following operation will verify one's suspicions. In cases of perforation of the esophagus, Pearse declared that no difficulty will be encountered from persistent fistula or stricture. He said that the superior mediastinum, above the bifurcation of the trachea, is best drained through the neck. This is true particularly if pus has run downward from the cervical region, and, if the patient be tilted into a Trendelenburg position, it may be made to run upward. He asserted that dependent drainage must be obtained; this means keeping the patient's head down until drainage diminishes or ceases. Failure to do this will permit the formation of a residual abscess. When infection of the retrovisceral space has passed downward to, or has originated below, the fourth thoracic vertebra, Coller and Yglesias said that drainage should be carried out by external thoracotomy and resection of a segment of a rib.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

HEAD

Evans, W. H.: Thrombosis of the Lateral Sinus: A Survey of Current Opinion and Records. *Arch. Otolaryngol.*, 1938, 28: 959.

While thrombosis of the lateral sinus is the intracranial complication most frequently encountered after operations for mastoiditis, the number of cases observed by the average otologist is so small, and the diversity of opinion in the medical literature for the management of this serious condition is so great that Evans drew on the larger collective experience of his confrères in formulating criteria for its management. A questionnaire addressed to approximately a thousand physicians and hospitals brought 343 replies. From this correspondence a collective series of 59,850 cases of mastoid disease was compiled, with 1,556 cases of thrombosis of the lateral sinus, an incidence of 2.6 per cent. Only 92 replies contained specific information regarding mortality; 305 deaths (a mortality of 31.2 per cent) occurred in a series of 979 cases of thrombosis.

In general, the incidence of thrombosis seems to be higher in children's hospitals and charity hospitals, and in private practice largely among referred patients. There is no evidence, either from the correspondence or a survey of recent literature, that the type of treatment influences the mortality. This seems to be affected more by the age of the patient, the virulence of the infection, and the presence or absence of complications. It is questionable whether climate has any influence on the incidence of thrombosis of the lateral sinus, although it may affect the incidence of mastoid infection itself.

Despite the growing number of authors who oppose operative intervention on the jugular vein in the treatment of thrombosis of the lateral sinus, the survey shows that exposure of the sinus with ligation of the jugular vein is still the method of choice of a preponderant number of otologists. This surgical procedure is accompanied by transfusions and the administration of specific serums, tonics, and drugs, such as sulfanilamide. Evident disagreement exists concerning the wisdom of attacking the jugular vein, the efficacy and effect of transfusions, and the rôle that sulfanilamide should play in the treatment of this condition.

Since the experience of the individual otologist with thrombosis of the lateral sinus is necessarily limited by its comparative rarity, Evans believes that the only way in which additional knowledge and improved management can be acquired is by the collective experience of the members of the medical profession. He pleads for careful observations, and complete and accurate records. The individual otologist can hope for improved results in a condition in which the mortality is approximately one-third, only if the collective experience and wisdom of the members of the profession is available to him.

NOAH D. FABRICANT, M.D.

Kazanjian, V. H.: Ankylosis of the Temporomandibular Joint. *Am. J. Orthodont. & Oral Surg.*, 1938, 24: 1181.

This article presents a clinical study of 33 cases of chronic ankylosis of the jaw. The cases may be divided into two groups: those in which the ankylosing factors lie in the joint proper, intra-articular or "true" ankyloses (28 cases); and those in which the pathology lies outside of the joint proper, the "false" ankyloses (5 cases). Complete ankylosis is taken to mean less than 5 mm. of opening power. The ankylosis may be unilateral or bilateral.

The predisposing cause is either disease or trauma. Infection may have occurred in the joint itself, in a suppurative process in the neighborhood of the joint, in the mandible, in the middle ear, or in the mouth. So-called congenital ankylosis is at present considered as evolving from a birth injury, and thus to be traumatic in origin. Injury is the most important single cause of ankylosis, and was present in 8 of the 28 cases of intra-articular ankylosis. Half of these cases of intra-articular ankylosis had their onset in the first ten years of life. The second decade gave rise to 4 cases, and the following decades to 6. The etiological factor or factors were well defined in the author's 5 cases of extra-articular ankyloses. Post-irradiation injury and scarring following the treatment of intra-oral carcinoma accounted for 2 cases; injuries involving the coronoid process caused 2 cases, and postdiptheroid intra-oral scars caused 1 case.

The duration of the ankylosis, the etiology, and roentgen studies are of some help in forming a preoperative estimate of the pathology, but in general one must wait for the surgical exposure of the joint before an accurate picture is obtained. It is important to know that in these cases, even with complete ankylosis for many years, the unaffected opposite joint remains perfectly normal. Bilateral cases of ankylosis are rather infrequent (4 in this series) and usually follow rheumatoid arthritis, or injury in which the traumatic force is transmitted to both joints of the mandible. There were 11 cases of partial ankylosis and 17 cases of complete bony ankylosis. True osteomas extending either from the posterior surface of the head of the condyle or the

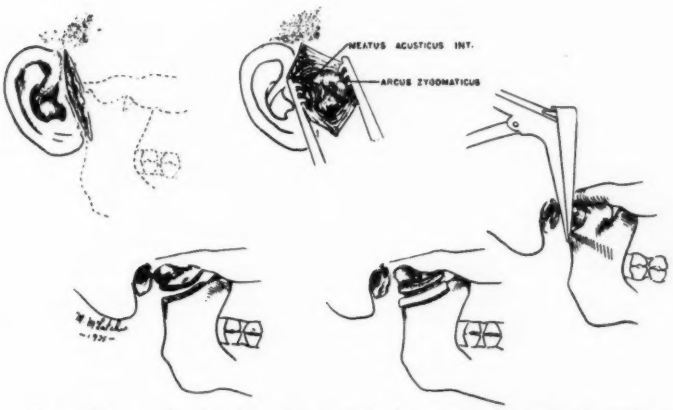

Fig. 1. Diagram showing the various steps in the operative procedure for arthroplasty of the temporomandibular joint. Incision line; exposure of operative field; position of the back biting forceps at the initial cutting; the line through which definite section of bone is removed; a sufficient amount of fascia is inserted between the cut ends of the bone to eliminate "dead" space.

coronoid process are especially noticeable in cases of partial ankylosis. The overgrowth of bone is primarily responsible for the limitation of motion. When the ankylosis is complete the hypoplasia of the mandible is most distinct. There are two explanations offered for this hypoplasia. The first is that the ankylosed joint directly affects an important growth center in the condyle and thus interferes with normal growth. The second is that lack of proper function leads to the hypoplasia. There is considerable evidence that interference with normal growth centers is the most important factor. Moreover, in bony ankylosis the unaffected side grows almost to normal size despite the fact that it has been largely deprived of its function. In complete ankylosis there is often a very great degree of decay on the occlusal surfaces of the teeth. Patients suffer but slight difficulty with their speech. The limitation in jaw function, the poor mouth hygiene, and the deformity are the main factors of disability. With the extra-articular lesion the joints themselves are normal and the jaw glides forward equally on both sides and with no deviation to the left or right. With an intra-articular ankylosis there is no forward motion on the affected side and this results in a slight deviation of the chin to the affected side. In bilateral ankylosis (intra-articular), no forward thrust is possible. This valuable sign can generally be elicited. Slight opening and lateral movement are always possible because of the elasticity of the mandible itself, even with complete bony ankylosis. Roentgen studies of both joints must be made. In the early cases of intra-articular ankylosis the shortening of the ramus on the affected side is notable. Blair has described the presence of a deepened preangular notch on the affected side in these cases.

Mechanical devices may be of value in extra-articular ankylosis, but are of no value and should not be employed in the intra-articular variety. No forceful opening of the mouth under anesthesia should be employed since the damage predisposes to firmer ankylosis. Surgery should be used as soon as possible in the intra-articular ankylosis. The youngest patient in this series was five years of age. In bilateral ankylosis only one joint should be operated upon at a time. In 1 instance two years elapsed between operations. No mouth gags or dilators are needed. If retrusion of the jaw is present, this is corrected at a later date. Dangers to be avoided in the operations are injury to the facial nerve, the internal maxillary artery, and the rich venous supply in the region of the joint. High section on the ramus of the mandible is necessary for optional functional results. The technique is illustrated in Figure 1. Anesthesia requires nasal or oral tubes with aspiration apparatus at hand. Rectal anesthesia has also been employed. Postoperative rest for the jaw is enforced for one week. No patient was hospitalized for more than three weeks. Deformity of the jaw may be corrected in the same manner as similar deformities are corrected following osteomyelitis, fractures, or other causes.

MANUEL E. LICHTENSTEIN, M.D.

EAR

Tumarkin, A.: A Contribution to the Study of Middle-Ear Suppuration, with Special Reference to the Pathology and Treatment of Cholesteatoma. *J. Laryngol. & Otol.*, 1938, 53: 737.

Tumarkin challenges the assumption that the outer layers of a cholesteatoma are demonstrably

epidermic in nature, believing that there is nothing in the keratogenic power of cholesteatoma to prove an origin from epidermis. He suggests that the word "cholesteatoma" should be abandoned. Certainly the presence of cholesterin crystals cannot in any way be considered as specific, since they are found in all kinds of chronic accumulations.

A proposed new classification for inflammations of the middle-ear cleft places the infections of ciliated epithelium under the general heading of mesotympanic infections. In the case of pavement epithelium further subdivisions are: epitympanic (attic) retrotympanic (mastoid), and pre-tympanic (petrous) infections. Any such classification has the usual disadvantage that there is often a continuous gradation between different groups, rendering it impossible to draw a sharp dividing line between acute suppurative, and acute catarrhal otitis media. Nevertheless, each is a well defined clinical entity.

The author attempts to stress the essential difference between the two epithelia by the use of different adjectives. Thus, the ciliated epithelium reaction is either catarrhal or suppurative. The comparable reactions of the pavement epithelium are either the desquamative or the perforating. For clinical completeness, gross suppurations in the epitympanum, retrotympanum, and pretympanum are included. Strictly speaking, these are not reactions of the pavement epithelium, but of the underlying bone. Reactions in the sub-groups of epitympanitis, retrotympanitis, and pretympanitis are practically identical, and in each case there is a chronic, enclosed infection yielding the condition known as primary cholesteatoma. When the condition perforates, the standard type of secondary cholesteatoma ensues.

In discussing the differences between his own theory and the metaplasia theory, the author denies the extraneous or fortuitous origin for primary cholesteatoma as well as for secondary cholesteatoma, denies that metaplasia takes place, and affirms the identity of all posterior-superior perforations. Koerner's criteria are in no way regarded as proof that the condition is of congenital origin.

Tumarkin describes his personal experiences with 9 cases of transmeatal atticotomy. These had resisted the most persistent conservative treatment for anywhere up to six months, and would normally have been subjected to one or another of the major mastoid operations. The author claims that transmeatal atticotomy can cure certain cases of otorrhea which have resisted persevering conservative treatment. The only reservations are that there should be no evidence of intracranial complications and that the mastoid should be of the acellular variety. The operation is a comparatively minor procedure, quite safe, and may be performed on out-patients. A hospital stay of from one to three days may be required in some cases. Even when it fails, a subsequent mastoid operation will be found much easier than usual, and more likely to achieve functional improvement. The functional results are likely to be much better than those which would be obtained from any other operation.

NOAH D. FABRICANT, M.D.

NECK

Krapf, H.: Cervicofacial Actinomycosis. Its Treatment and Prognosis (Die cervico-faciale Aktinomykose. Ihre Behandlung und Prognose). Erlangen: Dissertation, 1938.

The author evaluates his experiences in 29 cases treated for actinomycosis about the face and throat at the Surgical University Clinic of Erlangen during the years from 1921 to 1937. He was able to recheck a part of the material.

In 3 additional cases the infection was located respectively in the thoracic wall, the inguinal region, and the upper abdomen. The last-mentioned case, probably caused by a stab-wound acquired a long time ago, healed completely. In the other 2 cases general infection occurred, and both patients died within a year.

In his summary based upon the most important clinical pictures, the types of treatment, and the extension of the actinomycosis, the author expresses his opinion that actinomycosis is caused by organisms lying somewhere between bacteria and fungi, but more nearly resembling bacteria. The portal of entry is chiefly the mouth and pharynx; the actinomycosis invader is ingested along with plant particles. A transmission from person to person or from animal to animal cannot be assumed. The incubation period could not be determined. Actinomycosis is almost exclusively limited to dwellers in the country. Repeated occurrence was observed in North Germany, particularly Pomerania. Damp climates are more favorable to the fungi than dry climates. The prognosis for the cervicofacial type is more favorable when the condition is recognized early. Spontaneous healing may sometimes follow exclusion of the glands. Treatment should be begun immediately on the slightest suspicion that the condition be present. A general remedy does not exist. The treatment should consist of a logical combination of surgery, and iodine, and irradiation therapy. By means of this régime, 25 of 29 cases were cured; 2 are showing improvement; and 2 in which the actinomycosis was very extensive terminated fatally: 1 from metastasis to the brain. The literature is almost entirely limited to that appearing during the twentieth century.

(HEINEMANN-GRUEDER). NOAH D. FABRICANT, M.D.

SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS; CRANIAL NERVES

Martland, H. S.: Spontaneous Subarachnoid Hemorrhage and Congenital "Berry" Aneurysms of the Circle of Willis. *Am. J. Surg.*, 1939, 43: 10.

In 10,000 routine autopsies made by the Office of the Chief Medical Examiner of Essex County, New Jersey, 7,500 deaths were attributable to homicide, suicide, automobile accidents, and other forms of violent death. Twenty-five hundred deaths were sudden and unexplained, but were ultimately found to be due to natural causes. Of these, 54 were found to have occurred as a result of spontaneous subarachnoid hemorrhage. Post-mortem examination of the 54 patients revealed ruptured intracranial aneurysms in 38; in 9, the bleeding was due to ruptured hypoplastic cerebral arteries, usually associated with status lymphaticus. The cause of the bleeding was not determined in 5 cases; 1 arteriosclerotic aneurysm and 1 arteriosclerotic vessel had ruptured.

The author goes on to discuss all the accepted views on intracranial aneurysm, as well as the pathogenesis. An account of the symptoms and signs is offered from the writings of others. It is pointed out that only in exceptional cases can the diagnosis be made before rupture. Occasionally, roentgen rays may be of assistance in the diagnosis, either because of a calcified vessel wall or by the use of arteriography.

The Medical Examiner is of the opinion that recovery in cases of subarachnoid hemorrhage is not due to intracranial aneurysm. He believes also that trauma is not a causal agent of congenital aneurysm. In the cases of 21 patients death occurred very suddenly; in the cases of 33 death did not occur until after one hour; in 6 cases death occurred in six days; and in 2 cases after the attack.

ADRIEN VERBRUGGHEN, M.D.

Sjoeqvist, O.: Studies on Pain Conduction in the Trigeminal Nerve. A Contribution to the Surgical Treatment of Facial Pain. *Acta psychiat. et neurol.*, 1938, Supp. 17.

This extremely thorough work is divided into the following subjects: the morphological and physiological peculiarities of the nerves conducting the different qualities of sensation; analysis of the fibers of the trigeminal root; analysis of the fibers and studies of the degeneration in the trigeminal nucleus; pain conduction in the face; a new method of operative treatment of trigeminal neuralgia; and division of the bulbospinal tract.

Operative treatment of trigeminal neuralgia culminates today in the question of the possibility of doing away with pain and at the same time leaving intact the sensation of touch. Krause's ablation of the ganglion and Spiller and Frazier's temporal division of the root produce anesthesia of all sensation qualities. Dandy asserts that tactile sensation is preserved by intradural operation by the posterior route, with division of the nerve root where it leaves the pons, since at this point there is already a morphological differentiation of the different qualities. Others, and among them the author of the present work, deny this. According to Dandy, the pain fibers of the roots come together on the posteroinferior margin of the root near the pons. According to the author's researches, it appears that the separation takes place within the brain stem and cord, and that the bulbospinal tract (the so-called descending nucleus) contains only pain and temperature fibers. More recent researches in nervous physiology (Erlanger and Gasser, Adrian and Zottermann, and Haeggqvist) have demonstrated that the rapidity of conduction in nerve fibers varies according to the thickness of the fiber, and that the different qualities of sensation are likewise connected with definite degrees of thickness of the fiber. It is therefore possible to determine the different speeds of conduction electrically (with the electroneurograph); in the mixed nerve or in the spinal-cord root the curve shows various peaks, according to which the fibers are divided into the following groups: A (α, β, γ), B and C with the speeds 80; 50; 30; 20—10; and 1.6—1.3 m. per second. On the other hand it is known that nerve fibers of a diameter of from 15 to 10 microns conduct muscle sensation; from 12 to 8 microns, touch; from 5 to 4 microns, heat and cold, and 4 microns or less, pain. Whether groups B and C both conduct pain or C takes care of the sympathetic conduction is not yet clear. Questions as to the difference in thickness of the medullary sheath and as to the dichotomic branching of the nerve fibers are considered in this connection. The researches in fiber analysis require a special technique for preparation of the sections and for staining, and in taking into account the sources of error exact mathematical formulas are used. Macroscopic examination of the trigeminal root shows that a distinct plexus triangularis (Krause) is constantly present, and much mingling and crossing of the fibers. The number of fibers in the trigeminal root is estimated at 140,000. Some very good views of cross sections of the fibers show that there is no important difference between the different segments of the root from the ganglion to the pons and that thick and thin fibers are everywhere intermixed. Exact reckonings have determined that the fibers under 4 microns in diameter (pain and temperature fibers) in the upper part of the root are most numerous throughout the entire length. This renders improbable the theory of an embryonic rotation of higher grade in the trigeminal root. Nowhere was there found any clear-cut demarcation between

fibers of different thicknesses which would justify the idea of the possibility of a dissociated anesthesia by partial division of the root. No such differentiation could be made out even close to the site of entrance into the pons (conus glialis).

Examination of the bulbospinal tract revealed a different picture. First the author emphasizes the difficulty and confusion of the anatomical nomenclature and describes with exactitude the anatomical location of the tract. The fiber analysis was made on monkeys' brains. It was found that the great majority of the fibers of the tract have a diameter of less than 4 microns and that the much thicker fibers of tactile sensation are present only in the upper portion, and there but scantily, and disappear completely as they descend. Photomicrographs of a human tract give the impression that the tract is also composed of thin fibers, but it is more difficult to carry out Haeggqvist's fiber analysis in a strictly mathematical manner. Studies of the brains of patients on whom root division had previously been done by Olivecrona gave the following evidence of degeneration in the trigeminal tract: the portion of the root which is sectioned by Dandy's operation corresponds to the upper (dorsal) portion of the trigeminal tract. Here are found maxillomandibular fibers. The diameter of the tract is about 2 qmm. at the level of the superior olive and 1.5 qmm. at the level of the decussation of the pyramids; it therefore decreases relatively little, but the bundles lie further apart in the upper portion and tend to fuse in the lower portion. In discussing pain conduction in the face, the author refers to Wallenberg's syndrome: dissociated paralysis resulting from occlusion of the posterior inferior cerebellar artery. This, too, shows that the temperature and pain fibers are to be found in the bulbospinal tract of the same side, while the quintothalamic tract, which is affected in syringobulbia, contains tactile fibers.

After these fundamental investigations and discussions, the author describes his method of division of the bulbospinal tract, a method analogous to chordotomy. The operation is carried out under local anesthesia with morphine and luminal combined with evipan general anesthesia for the operation on the intradural portion of the nerve fibers. The exposure is the same as for operation on the cerebellum. After elevation of the tonsils and the restiform body, the roof of the fourth ventricle is opened. The incision lies caudal to the last roots of the vagus and at a level between the middle and lower thirds of the eminentia olivaris. The incision is from 3 to 4 mm. long and from 3 to 3.5 mm. deep. The most important of the possible complications of the operation is accidental injury to the root of the vagus (paralysis of the recurrent nerve). Very interesting is the appearance of herpes zoster of nuclear origin after the operation.

To date the operation has been performed in 9 cases. In spite of the theoretically good basis for this operation, the impression given by these 9 cases is not convincing, and one does not get the feeling that the results are proportionate to the magnitude and boldness of the intervention. It must, however, be borne in mind that the cases were not very favorable ones and that the observation time has been too short. In 4 cases there was atypical neuralgia, in 1 case herpes neuralgia, and in another neuralgia secondary to aneurysm. In 3 cases the root had been resected or clamped off previously without success. In another 3 cases the result of the tractotomy was entirely negative, and in the remaining cases improvement or freedom from pain followed the operation, but the observation time has still been short. The analgesia obtained was total in some cases and partial in others; in 1 case the analgesia extended to the neck; and 1 patient complained of numbness of the lower extremities. Secondary phenomena were herpes, paralysis of the recurrent nerve in 4 cases, and occasionally postoperative headache. It remains, therefore, for the future to show whether the new operation worked out by the author justifies itself; in any case this study has very real value for our knowledge of trigeminal neuralgia.

(F. Haertel). Florence A. Carpenter.

SPINAL CORD AND ITS COVERINGS

Schajowicz, F.: The Microscopic Structure and Pathology of the Intervertebral Discs in the Young (Contributo alla struttura microscopia e alla patologia dei dischi intervertebrali nei giovani). *Chir. d. organi di movimento*, 1938, 24: 5.

Vertebral growth occurs at the junction of the osseous diaphysis with the cartilaginous epiphysis. This area is called the zone of proliferation. In this zone are found the so-called islands of ossification (Fig. 1), which should be considered as specific to the zone of proliferation of the vertebræ. Microscopically these islands of ossification are seen as structureless masses, staining a deep blue color with hematoxylin-eosin, studded here and there with reddish scars, and lying in parallel fissures. These fissures may be filled with a light blue liquid, or may show a bright-red fibrinoid investment. The islands of ossification do not present an obstacle to the ossification of the zone of proliferation. Their function is probably to fix the zone of proliferation and to render it more resistant. They first appear towards the fifth year.

The intervertebral disc consists of the nucleus pulposus, annulus fibrosus, and the cartilaginous plate adherent to the vertebra. The function of the cartilaginous plate is to resist the pressure of the nucleus pulposus, and to transmit it elastically to the vertebral bodies. It reflects itself around the margin of the vertebral body, extending a short way along the anterior border of the body, and ending by slightly re-entering the body in a step-like formation. This step-like formation is first seen at the third year; by the fifth year it is clearly visible; and toward the ninth year it begins from the side of the vertebral body. This formation is sometimes seen in individuals from fifteen to eighteen

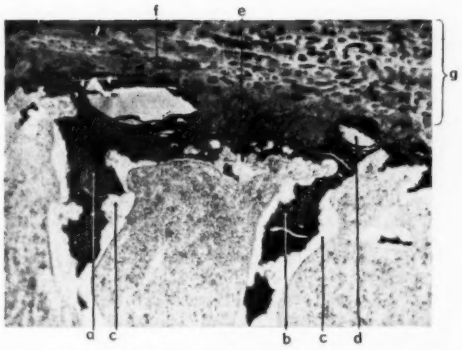

Fig. 1. (a and b) Two islands of ossification which penetrate deeply into the spongiosa of the diaphysis (c); (d) mucus-like fluid in one of the fissures of an island of ossification; (e) zone of proliferation; (f) nidus of calcification above an island of ossification; (g) cartilaginous plate.

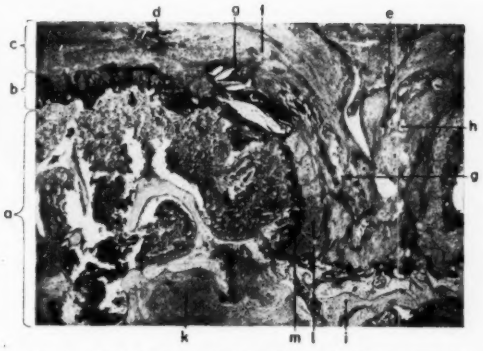

Fig. 2. Cartilaginous nodule in an eighteen-year-old; (a) vertebral body; (b) zone of proliferation; (c) cartilaginous plate, which at (d) shows foci of degeneration, and at the superior margin of the cartilaginous nodule (e) is thinned and terminates in (f), folding itself towards the medulla. Island of ossification (g) at the superior margin of the cartilaginous nodule. The prolapsed nucleus pulposus contains numerous calcareous chips (g, 1), and foci of degeneration (h), horizontal tract of sclerosed spongiosa (i) which intercepts the prolapse. The cartilaginous nodule shows at right and left a zone of cartilaginous proliferation (l) and a zone preparatory to calcification at (m).

years of age. The epiphysis calcifies in a disc-like manner. The calcium is deposited irregularly, at first in the posterior margin of the vertebra, and later in the anterior margin. Calcification of the epiphysis begins at the fifth year, and by the twelfth year it is about complete. From the thirteenth to the fourteenth year marginal ossification of the calcified epiphysis begins. Due to this marginal ossification the osseous epiphysis is developed as a ring and not a disc. Contrary to calcification, ossification of the epiphysis begins at the anterior end of the vertebral body. By the twentieth year osseous fusion between the diaphysis and epiphysis begins, and is completed by the twenty-fourth or twenty-fifth year.

The vertebral epiphysis is supplied by six vessels: two dorsal, two ventral, and two lateral. Involution of these vessels may give rise to areas of degeneration through which the nucleus pulposus may herniate. Besides this, areas of degeneration are often found toward the central part of the epiphysis where the pressure from the nucleus pulposus is greatest. The prolapsed tissue has in its upper part the same structure, and shows the same degenerative changes as the nucleus pulposus from which it is derived. Besides, there is regularly found a greater or lesser number of calcareous chips, taking a light blue color, which are derived from the zone of proliferation, which at one time was found at this place. These calcareous chips are absolutely characteristic of hernia of the intervertebral disc in young individuals. The prolapsed intervertebral disc, which is seen as a cartilaginous nodule (Fig. 2), causes sclerotic and reactive changes in the vertebral diaphysis. Exactly in front of a prolapse, ossification may advance more than any other place. This may give rise to convex reliefs directed toward the prolapse. These convex reliefs are often seen on roentgenograms (Fig. 3), even though the cartilaginous nodules are not. DAVID IMPASTATO, M.D.

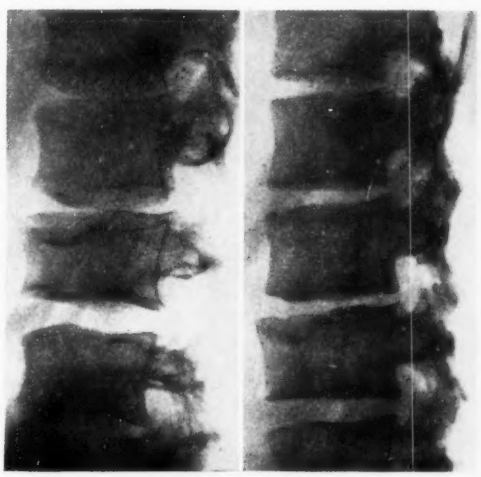

Fig. 3. Lateral radiogram of the first to the fifth lumbar vertebræ of an eighteen-year-old patient. The intervertebral space between the second and third lumbar vertebræ is diminished. The top of the third vertebra shows a large cartilaginous nodule, which reaches the anterior end of the vertebra, digs deeply into the spongiosa, and has a thick, sclerotic margin. A smaller cartilaginous nodule may be seen at the lower margin of the same vertebra, near its anterior end. The upper margin of the fourth vertebra shows a convex relief directed toward the intervertebral disc

Fay, T.: The Localization and Treatment of Lesions of the Spinal Cord. *Surg. Clin. North Am.*, 1938, 18: 1577.

In the majority of cases of lesions of the spinal cord, pain is the one common symptom that is familiar to both the patient and the clinician. It is the most primitive sensory mechanism of the nervous system, and maintains the early segmental pattern of the nervous system. The superficial plan of the pain-fiber network still maintains its segmental pattern, and when extended to the skin surface is referred to as a dermatomere. The dermatomeres extend from the oral to the anal end of the body. Pain contrasts with the sensations for heat and cold, and with the tactile discriminatory sense, in that the latter extend from a half to a full dermatomere on each side of their own segment with consequent decrease in reliability, from the standpoint of localization. Because the vascular system arises early, it carries with it those elements of the nervous system which are first associated with the cardiovascular apparatus; namely, fibers from the thoracic cord. This origin explains the characteristic projections of pain in the case of vascular diseases.

The clinician can, in a few minutes, with an ordinary pin and a test tube filled with ice water, determine whether the areas of the body, at and below the level complained of by the patient, retain their full appreciation for these sensations. Hyperalgesia and an increased recognition of cold are signs of spinal-root irritation. A comparison of pain and cold appreciation in the two lower extremities, as well as a comparison between this portion of the body and the face, should clinically establish whether or not the spinal pathways are intact. The patient should be co-operative and fully exposed for an examination.

Pinpoint or a cold tube should be drawn rapidly over the surfaces of the body from the region of the buttocks to the heel, on the inner aspect of the leg to the groin, then to the axilla, and, following a course along the inner aspect of the upper extremity, to the little finger; then from the base of the thumb to the shoulder cap, and, finally, over the neck and onto the face. In this way every segment of the body will be examined in its proper sequence.

Characteristic responses to drawing a pin over the surface of the body in an early case of spinal-cord tumor will be as follows:

1. The patient will readily recognize the pinpoint as pain, but when the normal area is reached the increased sensitivity will be noted as more painful.
2. At the root level of the tremor an area of hypersensitivity will be encountered which should be well mapped out.
3. Painful stimulation through counter-irritation yields vasomotor flushing; the scratch of a pin may give rise to a wheal along its course that will clearly pick out the root segments involved; light reflected off the skin may give a dusky, pigmented, and slightly sunburned appearance.
4. Percussion of the spinous processes usually yields pain over the site of the lesion.
5. Pressure of the thumb downward and laterally over the spinous processes usually yields marked discomfort at the site of the lesion.

An additional aid is the myelogram which is obtained by the withdrawal of some spinal fluid, the introduction of a small amount (20 c.cm.) of air or oxygen, and the use of stereoscopic x-rays. The myelogram will frequently demonstrate defects due to various types of lesions. This procedure has many advantages over that in which lipiodol is used, as this substance is not absorbed and may be a source of severe irritation. In the author's clinic, myelograms have been taken in 130 cases with very gratifying results.

The operative care of patients with cord tumor requires special attention to the matter of shock and to the care of the bladder. At operation, the wound is carefully irrigated to remove the by-products of trauma, which are believed to be responsible for shock. Hexamethylenamine is used routinely for the bladder; and in severe cord lesions suprapubic cystotomy is recommended.

JOHN WILTSIE EPTON, M.D.

CHRONIC CYSTIC MASTITIS AND CARCINOMA

Collective Review

DAVID H. PATEY, M.S., London, England

INTRODUCTION

THE problem of the relation of chronic cystic mastitis to carcinoma is of immense practical and theoretical importance in the surgery of the breast, as on it hangs the possibility of prophylactic treatment of the potentially carcinomatous breast. The recent literature contains many good reviews, among which may be specially mentioned those of Campbell (9), Goldzieher and Kaldor (23), Harvey (27), and Semb (48).

Campbell divides the history of the condition into three periods:

1. An early period, belonging chiefly to the middle of the nineteenth century, in which the views of surgeons on cystic disease of the breast depended almost entirely on clinical experience. During this period, with which are associated such names as Paget, Brodie, Birkett, Gross, and Velpeau, the disease was regarded generally as benign in nature and significance.

2. A period beginning toward the end of the nineteenth century and continuing into the present century, during which more attention was paid to microscopical appearances. On account of the frequency with which epithelial hyperplasia was noted, cystic disease of the breast came to be more suspected, and as a result amputation of the breast as a prophylaxis against carcinoma became more common. The names of Reclus and Schimmelbusch belong to the early days of this period.

3. A period extending up to modern times, characterized by a conflict between these two points of view and associated conflicting views on the etiology and treatment of the disease.

EXPERIMENTAL EVIDENCE

The literature of the last ten years or so, with which the present review is chiefly concerned, falls principally under the last heading. The same years, however, have also seen the emergence of evidence of a completely new kind, the result of the great advances that have taken place in our knowledge of the hormones. We seem now to be entering upon a distinct new phase in breast pathology, the principal feature of which will be the correlation of the facts elicited by hormonal experiments in animals with those of clinical experience. Therefore, the first subject calling for review is the experimental evidence bearing on the relation of cystic mastitis to carcinoma.

Nelson (46) has summarized our knowledge of the normal endocrine control of the mammary gland. While there are differences in different species, in most animals estrin controls the duct systems of the breast, and the corpus-luteum hormone the acinar systems. The hormone from the anterior lobe of the pituitary gland acts on the breast indirectly through the gonadotropic hormones and the gonads, and directly through its lactogenic hormone. Passing from physiology to pathology, the most clear-cut pathological pictures have been produced by estrin. It has been shown that the continued administration of large doses of estrin gives rise in many species of animals to marked proliferation of the duct systems of the breast, dilatation of the ducts with secretion, cyst formation, epithelial proliferation, and proliferation of inflammatory cells. These changes seem to be most easily produced in the mouse and the rat. They have been produced in the mouse by Goormaghtigh and Amerlinck (24), Lacassagne (33, 34), Loeb and his collaborators (39, 49), Bonser and his collaborators (5, 6), and Burrows (8); while Gardner and his collaborators (18, 19) showed a similar spontaneous condition in the breasts of a mouse associated with and, he believed, caused by, bilateral granulosa-cell tumors of the ovaries. In the rat similar changes in the breast from estrin injections have been produced by Ashwood and Geschickter (2), and Herold and Effkemann (28). Similar changes of a lesser degree have been produced in monkeys by Geschickter and Lewis (20, 22), and in rabbits by MacDonald (40), though Fifer (16), states that a lesion resembling chronic cystic mastitis is common at certain periods of the sexual history of this animal. Apart from cystic disease, it has been shown by Lacassagne, in experiments that are now classical, that in the mouse the continued administration of estrin may lead to the development of carcinoma of the

breast. Lacassagne showed that the facility with which cancer of the breast was produced in mice with estrin depended on the degree of hereditary susceptibility to cancer of the strain of mouse used. Lacassagne's work has been fully confirmed by Bonser (5, 6), Burrows (8), Cramer and Horning (13), Gardner et al. (18, 19), and Loeb et al. (39, 49).

The evidence is thus clear that diffuse cystic disease of the breast can be produced in many animals by the administration of estrin, and that in the mouse continued administration of the estrin may lead to carcinoma of the breast, and many workers have not hesitated to regard the condition as comparable with cystic mastitis in the human being, and to refer to the experimental work as proof of the precarcinomatous nature of chronic cystic mastitis. Thus Goormaghtigh and Amerlinck (24) have as the title of their paper, "Realisation experimentale de la maladie de Reclus de la mamelle chez la souris"; and Cheatle (11) states that the microscopical changes in the breasts of Lacassagne's mice are the same in sequence and in kind as those met with in human cystic disease, which he had always held to be a precarcinomatous condition. Some writers on the other hand sound a note of caution. Taylor (50, 51) points out that many difficulties remain to be overcome before human cystic disease of the breast and carcinoma can be explained on a hormonal basis. He argues that there is no special history of uterine disturbances in these cases, such as would be expected from excess estrin action; that there is no evidence of excess of estrin in the blood or urine, and that the age at which these conditions occur is usually at a time when ovarian activity is approaching or has passed the climacteric. Experimental work does, however, supply some possible lines of reply to these objections. Lathrop and Loeb (35) showed as long ago as 1916 that, whereas castration of female mice below the age of six months usually prevents the subsequent spontaneous development of carcinoma of the breast, after this age this procedure was without effect. In other words, the pathological condition may develop long after an exciting factor has ceased to act; and more recently Geschickter (21), in 1934, reported a case in which large amounts of estrin were found in a fibro-adenoma of the breast, thus raising the possibility of the breast tissue concentrating the hormone.

The present experimental evidence can therefore be summarized as follows:—

1. Cystic disease of the breast closely resembling cystic disease of the human breast can be produced in a variety of animals, but in particular in the mouse and the rat, by the continued administration of large amounts of estrin.

2. In mice of a strain susceptible to cancer, such cystic disease may lead on to carcinoma of the breast.

3. Cystic disease is not necessarily followed by carcinoma of the breast since it does not occur in the rat nor in mice of a cancer refractory strain. (Evidence has recently been brought forward by McEuen (42) that very exceptionally carcinoma may be produced in the breasts of rats.)

The evidence thus shows that cystic disease of the breast may be a precarcinomatous condition in animals, but this does not answer the question whether it is so, and if so, to what extent in man. The problem for man might be restated in the form of the question, "Is man comparable in this respect to the mouse or the rat?" The answer to such a question can be given only after observation and experiments on man.

HISTOLOGICAL EVIDENCE

The evidence in man may be histological, clinical, or a combination of the two, clinico-histological. The purely histological evidence is of two types:

1. The evidence of the changes of chronic cystic mastitis in breasts removed for developed carcinoma.

2. The evidence of unsuspected carcinomatous changes in breasts removed for chronic cystic mastitis.

However, both carcinoma of the breast and chronic cystic mastitis are not uncommon conditions, so that the possibility of their coincidental occurrence has always to be considered. Histological evidence, therefore, to be of real value requires control by means of observations on the normal microhistology of the breast and on the incidence of unsuspected chronic cystic mastitis in the general body of the population. Unfortunately, on neither of these two points does stability exist. It is difficult to say what is the normal histology of the breast. Dawson (14), who made a special study of the normal breast, referred to the differences in structure in different individuals, and these have also been pointed out by other writers. In addition, there are variations according to age and the phase of sexual life. It has even been suggested that there are considerable differences in the same breast at different phases of the menstrual cycle, and a considerable literature has grown up on this point [see Rosenburg (47), Lewis (36), Taylor (50, 51), and Ingleby

(29)]. Again, probably arising out of the difficulty of determining the normal range of microscopical changes in the breast, the reported incidence of chronic cystic mastitis as determined by routine examination of post-mortem subjects varies with different writers. Thus McFarland (43) found it in 15.33 per cent of his cases, Keynes (31) in approximately 50 per cent, and Borchardt and Jaffé (7) in 93 per cent.

The most complete work on the subject of the pathological histology of the breast is that of Cheatle (12), and the monograph is already a classic. Their answer to the question is definite. They affirm that, "about 20% of all carcinomata of the breast can be definitely stated to begin within the lesions of the cystiphorous state." They also affirm that, while the calculation of the proportion of cases of cystic mastitis that become carcinomatous is much more difficult, the whole sequence of changes from desquamative epithelial hyperplasia, through cyst formation, up to benign neoplasia, and finally carcinoma may be traced histologically. They estimate that the postulated sequence of changes from cystiphorous hyperplasia to a carcinoma occupies about thirty years. They further state that carcinoma unsuspected clinically was found in 3 of 4 cases of chronic cystic mastitis treated by amputation, though they admit that this is an abnormally high proportion. On the other hand, as illustrating the variability of the evidence on this same point, Bloodgood (3) states that of 222 cases, in which the whole breast was removed for chronic cystic mastitis, not a single case presented gross or microscopical evidence of cancer. Charteris (10) examined microscopically and in detail 48 breasts removed for carcinoma. In all except 7 cases, chronic mastitis in some degree was present in some part of the breast. He also examined 32 unselected breasts from post-mortem subjects, and found similar changes of chronic cystic mastitis in only 5. From this he concludes that the chronic mastitic changes in the carcinomatous breast were related to the carcinoma and precursory to it. Fraser (17) noted similar epithelial changes in cancer of the breast to those described by Charteris, but, because these changes were particularly marked in centrifugal fashion around the carcinoma, he considered them to be secondary to the carcinoma and not precursory. Semb (48) found cystic mastitis in 77 per cent of 122 cases of carcinoma mammæ. He found similar changes in only 1 of 32 routine post-mortem cases, and from this he concluded that the chronic cystic mastitis and the carcinoma stood in some relation to each other. Morpurgo (45) found cystic changes present in 24 per cent of 196 carcinomas of the breast but gives no control figures, while, finally, Handley (25) developed in histological detail his argument that chronic mastitis is a precarcinomatous condition, both mastitis and carcinoma having a common pathology in lymphatic obstruction. There is general agreement among all writers, even those who hold strong views on the precarcinomatous nature of chronic cystic mastitis, that carcinoma developing actually in the wall of a large cyst is exceptional.

To conclude the histological evidence reference may here be made to a suggestion which occasionally appears both in the experimental and the clinical literature that the secretory and epithelial proliferative phases of chronic cystic mastitis are antagonistic, the former being benign and leading only to cyst formation, the latter possibly dangerous. While this suggestion is supported by some evidence, most cases of chronic cystic mastitis would appear to show both processes simultaneously, but in varying degrees.

CLINICAL EVIDENCE

Most of the purely histological evidence, therefore, suggests a relationship between chronic mastitis and carcinoma. Apart from the difficulties previously mentioned, however, the weakness of purely histological evidence lies in the difficulty of definite determination from its morphology of the biological potentialities of an epithelial cell. Eberts (15) an enthusiastic follower of Cheatle, goes so far as to state that "the diagnosis of cancer can now be made without histological evidence of infiltration." It is the supreme contribution of Bloodgood (4) to breast pathology that he has shown that this statement is untrue, having described cases presenting what histologists diagnosed as dangerous epithelial proliferation of the breast which were watched up to thirty years but did not develop carcinoma. The point has been well put by Johnson (30), who after paying tribute to the contributions of morbid anatomy to the pathology of the breast, stated that "on the other hand it is necessary to study without bias purely clinical evidence." The period reviewed in this article presents some interesting clinical material. However, just as the histologist starts with the difficulty of determining the border between normal variations and pathology in the breast, so the clinician has his difficulty in determining clinically the diagnosis of chronic cystic mastitis. On the one hand, well marked cystic changes and epithelial hyperplasia may be present histologically without any cor-

responding clinical abnormality in the breast. On the other hand, by no means all breasts that are painful and nodular show histologically chronic cystic mastitis. As Cheatle and Cutler (12) have pointed out, increased nodularity of the breast may be caused by atrophy or alterations in consistency of the supporting fat, alterations in the supporting fibrous tissue, and vascular changes at the menstrual period; while functional pain in the breast is not uncommon. Therefore in most cases, clinical examination is no guide to the presence or absence of epithelial proliferative changes in the breast. (The two conditions which are exceptions to this statement are Paget's ulceration of the nipple, and bleeding from the nipple, either of which symptoms is a clear indication of some type of epithelial hyperplasia in the breast.) The only really satisfactory cases of chronic cystic mastitis for follow-up, therefore, are either those in which the cysts are so large that their presence is demonstrable clinically, or those in which a diagnostic exploration has shown the presence of the changes histologically. Johnson (30) followed up for from one to twenty years and found no evidence of carcinoma in 61 of 107 cases of cyst of the breast which he had treated by local resection; in 2 other cases carcinoma had developed in the opposite breast and in still 2 other cases, in the breast of the same side. Bloodgood (4) followed up for periods up to thirty years more than 100 patients from whom blue-domed cysts had been removed from one breast, and of whom none had developed cancer. In a previous communication (3) he had referred to the follow-up of 128 cases of chronic cystic mastitis treated by local removal in which cancer developed in 3 (approximately 2 per cent), which percentage he states is the same as for normal breasts. (This figure of 2 per cent incidence of cancer in normal breasts is quoted by many authors and Bloodgood appears to be its originator. In the period under review, however, none of the authors who use this figure indicates how it was obtained. In any case there is the difficulty that a breast that appears normal clinically may show marked epithelial hyperplasia histologically. The bald statement that there is a 2 per cent incidence of carcinoma in normal breasts without reference to the criteria of normality or the length of time the individuals have been followed up is almost valueless.) Mathews (41) states that during twenty years he aspirated "fully 50 cysts," and that only 1 patient has developed cancer. Adair (1) in discussing Mathews' paper, also stated that carcinoma occurs after operations on blue-domed cysts in less than 2 per cent of the cases. Campbell (9) refers to 233 cases of chronic cystic mastitis treated by local excision of areas of breast tissue and followed up for from two to fourteen years. In 1 patient only did carcinoma of the breast develop. Eighteen per cent of the 233 patients had lesions in which epithelial hyperplasia was marked histologically, yet in none of these did carcinoma develop. Klingenstein (32) followed up for from two to eleven years 54 patients who underwent partial breast excision for chronic mastitis, of whom 2 developed carcinoma. Lewis and Geschickter (37) and Geschickter (20) report the follow-up of a large number of similar cases in which the incidence of carcinoma was less than 2 per cent. Moritz-Borchardt (44) brings forward an argument used by many surgeons in stating that he has treated with success so many cases of cyst of the breast by simple puncture that he cannot believe that they are related to carcinoma. A different picture is painted by Liedberg (38) who followed up for from five to ten years 40 patients who had had local excision of the breast for cystic disease; 28 of these were classified as having simple cystic disease, and 3 of them developed carcinoma; 10 were classified as having cystic disease associated with epithelial hyperplasia (including duct papilloma), and 3 of these developed carcinoma of the breast. The high incidence presented by Liedberg contrasts strikingly with the low incidence reported by the great majority of the authors.

Summing up the clinical evidence one may say that on the whole it points strongly in the direction that if clinically diagnosable cystic disease of the breast is a precarcinomatous condition, in actual practice the danger of carcinoma is so slight that even after many years carcinoma develops only in a small proportion of cases. In other words, if carcinoma is a danger in these cases, it is a danger which only rarely materializes in the human being.

SUMMARY AND CONCLUSIONS

If one tries to sum up the rather conflicting evidence, one may say that the purely histological evidence and the experimental evidence both point to a relationship between chronic cystic mastitis and carcinoma. The production of cystic disease of the breast in mice by means of estrin, from which carcinoma may develop under suitable conditions is conclusive for some relationship at any rate. On the other hand, the clinical and clinicohistological evidence brings out two points: (1) in the vast majority of cases it is impossible to recognize clinically the precarcino-

matous change for the simple reason that the histological abnormality may be associated with no clinical abnormality; and (2) the risk of carcinoma in cystic disease of the breast which is clinically diagnosable is slight. That the risk is only as slight as in a normal breast is asserted but not proved. From the practical point of view, therefore, one may conclude in dealing with clinically diagnosable cystic disease of the breast that while from a qualitative standpoint the theoretical possibility of the development of carcinoma must be admitted, from the quantitative point of view this possibility is not strong enough to justify the routine employment of such radical measures as amputation of the breast. Such a procedure might be indicated under special circumstances, as when there is a family history of carcinoma of the breast, but for most cases less radical measures combined with watching would appear to be the best course. Whether in the future it will be possible to prevent the development of carcinoma of the breast by interruption of the sequence of events in the precarcinomatous phase by some hormone, or some physical agent such as the x-rays, is a matter for speculation. On the present position of x-rays in this connection, Handley (26) concludes that "chronic mastitis is often amenable to deep x-ray treatment," but that "the protection afforded by x-rays is neither absolute nor permanent."

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SURGERY OF THE THORAX

CHEST WALL AND BREAST

Desaive, P.: A Comparative Study of 350 Benign and Malignant Tumors of the Mammary Gland (Étude comparée de 350 tumeurs bénignes et malignes de la glande mammaire). *Rev. belge d. sc. méd.*, 1938, 10: 533.

Desaive notes that a pure fibroma or a pure adenoma of the mammary gland is very exceptional; as a rule epithelial hyperplasia and connective-tissue proliferation are associated to form a fibro-adenoma.

At the surgical clinic of the University of Liége, there were 350 cases of tumor of the breast observed during the period from 1928 to 1935. Of these, 53 were initially benign, including 42 cases of fibro-adenoma, 9 cases of fibro-adenoma undergoing transformation into epithelioma, and 1 case each of pericanalicular fibro-adenoma (Moure) and intracanalicular fibro-adenoma (Muller). There were 297 cases of initially malignant tumor, of which 296 were glandular epitheliomas of various types and 1 was a melanotic sarcoma of the areola. Such a preponderance of malignant tumors is a general occurrence, as shown by reports from other clinics.

In a study of this series of benign and malignant tumors of the mammary gland at Liége, the author finds that the majority of patients with malignant tumors were between fifty and fifty-nine years of age on admission to the clinic, with fifty-four years as the mean. The majority of patients with benign tumors were between forty and forty-nine years of age, with forty years as the mean. On the basis of the history of these cases, the author finds that the mean age for the occurrence of benign tumors of the breast is thirty-seven years and for malignant tumors fifty-two years, a difference of fifteen years.

Of the 350 tumors of the breast in this series, only 6 occurred in males (4 adenocarcinomas, 1 fibroma, and 1 fibro-adenoma). Of the 344 women patients, 47 per cent of those with benign tumors and 45.9 per cent of those with malignant tumors had not borne children; the menopause had occurred in 29.5 per cent of those with benign tumors, and in 76.1 per cent of those with malignant tumors. These findings indicate that malignant tumors of the breast develop chiefly after the menopause at the time of the diminution of ovarian activity; it is possible that the failure of the ovarian hormone results in excessive secretion of the hormone of the anterior pituitary lobe, which may stimulate excessive cellular proliferation. Malignant tumor of the breast was associated with uterine fibroma and hyperplastic metritis in 20 cases, and with ovarian cysts in 5 cases.

In cases both of benign and malignant tumors, the left breast was somewhat more frequently involved than the right, and the most common site of the tumor was the upper and outer quadrant of the breast. Transformation of a fibro-adenoma of the breast into an epithelioma is relatively rare, as this was demonstrated in only 9 of the author's cases.

The fact that a transformation of fibro-adenoma into epithelioma is rarely observed and that the benign tumors of the breast develop at a different age period and under different "hormonal influences" as compared with malignant tumors leads the author to conclude that benign fibro-adenoma of the breast is not a precancerous lesion in the usual sense of the term. This does not, however, imply that surgery is not indicated in fibro-adenoma of the breast. Because of the difficulty of making a correct diagnosis without biopsy, and because of the possibility of malignant degeneration, or at least of atypical evolution of fibro-adenoma of the breast, the author considers that operative removal of such tumors is the treatment of choice.

ALICE M. MEYERS.

TRACHEA, LUNGS, AND PLEURA

Nissen, R.: Extrapleural Pneumothorax (Le pneumothorax extra-pleural). *Arch. méd.-chir. de l'appar. respir.*, 1938, 13: 196.

Tuffier, in 1891, was the first to advocate extrapleural pneumolysis, for detachment of the lung from the thoracic wall in cases with pleural adhesions. Twenty years later he used this same method for collapsing the lung in pulmonary tuberculosis. In 1913 Meyer perfected Tuffier's operation by including pneumothorax in the procedure as a routine; he called this "extrapleural pneumothorax."

In 1929 Nissen employed Meyer's procedure in the treatment of a case of tuberculosis of the apex of the lung, in which he had planned to do an apicolysis combined with partial thoracoplasty by resection of the upper ribs. However, the patient suffered a collapse when the apicolysis was completed, and the thoracoplasty was not done; but in order to maintain the apex of the lung in collapse, the apical cavity was repeatedly filled with air, as for pneumothorax therapy. The patient made a good recovery after the pneumothorax had been maintained for fourteen months.

Since that time the author has employed extrapleural pneumothorax on definite indications, chiefly in cases in which the usual method of pneumothorax was impossible because of adhesions and thoracoplasty was contraindicated by the patient's poor general condition. Extrapleural pneumothorax was first used in the treatment of tertiary cavities, but the method did not always give good results in this type of lesion. In 1 case the cavity perforated a few weeks after operation and death resulted, and in 2 cases there was hemorrhage with formation of a hematoma. The ultimate result was favorable in 1 of these 2 cases, but in the other no demonstrable diminution of the cavity was obtained. In some of

these cases poor results are due to insufficient collapse of the lung; in others, the collapse is sufficient while the pneumothorax is obtained, but when no more air is insufflated, the residual extrapleural cavity may fill with exudate requiring repeated punctures; in 2 cases the exudate became infected. If good results are obtained after discontinuance of the pneumothorax, the extrapleural cavity is obliterated; in such cases, the pulmonary cavities disappear, and the lesion in the opposite lung may heal to such an extent that the patient becomes free from symptoms.

Extrapleural pneumothorax is more definitely indicated and gives better results in cases with recently formed cavities, which have appeared during the active stage of the disease, and in which thoracoplasty is contraindicated. These lesions are usually in the upper lobe of the lung, and can be adequately collapsed by extrapleural pneumothorax, without complications or harmful effect on the opposite lung. The principles of the treatment are the same as those of the "classical" method of pneumothorax, but a positive pressure must always be maintained. The collapse of the lung with extrapleural pneumothorax is limited to the site of the cavity and immediately surrounding area. According to the site of the cavity, either the paravertebral, the anterior, or the axillary route may be used for insufflation; all have given good results. ALICE M. MEYERS.

Jorge, J., and Goni Moreno, I.: Bronchogenetic Secondary Hydatidosis (Hydatidosis secundaria broncogenética). *Rev. de cirug. de Buenos Aires*, 1939, p. 1.

The short number of observations published explains the classic conception of the healing of hydatid cyst of the lungs, after the cyst has ruptured and the patient expectorated the contents. Devé, the first to study this type of echinococcosis, suggested the possibility of bronchiogenic infection. The authors believe that hitherto only 16 or 17 cases of this condition have appeared in the medical literature. Almost all were found in Argentina.

The authors believe that the pulmonary cysts must be treated as soon as possible. The old idea that the cysts of the hilum require expectant treatment until the rupture and vomiting occurs must be changed; the expectant treatment should continue only until the natural growth makes surgical procedure easier.

The authors prefer the two-stage operation, having had the best results with it. It is necessary to wait until the cyst comes near the thoracic wall and in close contact with it. The cysts which develop near the hilum or toward the mediastinal face of the lung very often fail to fulfill this condition.

For this reason the authors believe that the last word on the treatment of the central cysts has not been pronounced and that very often, while one waits for their growth, one comes closer to the dangerous period of rupture. They cannot say which eventuality is more dangerous for the patient: either rupture with the possibility of healing, or difficult approach with the possibility of disaster.

The ignorance, for so many years, of this clinical condition and the few certain observations compared with the large number of ruptures in patients with pulmonary cysts convey the impression that the danger of bronchial dissemination is minimal. Nevertheless, Devé believes that it is more common than one thinks. Many cases have been cured by progressive elimination of the cysts, and their existence has not been noticed. For this reason it is important to respect, if possible, the central cysts, as long as they do not bring hemoptysis, and to perform the operation as soon as their growth brings them within reach.

Devé has shown experimentally how the bronchial flooding with the contents of a living cyst is followed by inflammatory lesions which disappear in ten days and leave a number of little parenchymal nodes called "hydatic granuly of Devé." Some nodes are eliminated, or degenerate, but some, after four and one-half months, become parabronchial, central, subpleural, or cortical lesions with the aspect of hydatid vesicles. These are eliminated by a number of small ruptures, which explain the scarceness of the bronchogenic echinococcosis after the rupture of the primitive cyst.

The authors describe a case which is, for Devé, the most convincing case observed in man. The patient was a young man in good health who had a hydatid cyst which ruptured and caused prolonged vomiting. Two years after this, having been cured, according to clinical and roentgenological findings, he was examined by means of the x-rays and many nodular, round shadows of different sizes, with the appearance of grapes, were observed in both lungs. There were no clinical manifestations that could be correlated with the seriousness of these lesions. The patient complained of the elimination, by means of short spells of vomiting, of some newly formed cysts, with a temporary augmentation of mucopurulent expectoration.

For this reason it is important that all patients who have vomited a ruptured cyst be observed periodically. Whether they will develop bronchogenic echinococcosis depends upon their defenses. If they are young and the collapse of the parenchyma prevents the appearance of inflammatory symptoms, the results may be good. However, the cases of complete healing are very few. The rest of the patients die of hemoptysis, cachexia, or pneumonia.

Devé believes that to consider a patient definitely cured one must wait for two or three days after the vomiting. Those patients in whom the lesions appeared after from fifteen to twenty years were probably re-infected. HECTOR MARINO, M.D.

Neuhof, H., and Touroff, A. S. W.: Acute Aerobic (Non-Putrid) Abscess of the Lung. *Surgery*, 1938, 4: 728.

The most serious pulmonary complication of necrosuppurative bronchopneumonia is aerobic

(non-putrid) abscess of the lung. Necrosuppurative bronchopneumonia is characterized (1) pathologically, by the co-existence of suppuration and necrosis involving one or more bronchopulmonary segments; (2) clinically, by the occurrence of fever and cough, and the expectoration of odorless pus; (3) roentgenologically, by the presence of one or more areas of pneumonic infiltration; and (4) bacteriologically, by the presence of aerobic, pus-producing bacteria in the sputum.

The stage at which necrosuppurative bronchopneumonia becomes pulmonary abscess cannot be defined precisely; the transition may take place rapidly or gradually, and may occur at any time.

Acute aerobic pulmonary abscesses occur in two forms, "interstitial" and "segmental." The former are usually very small, multiple, and of varied etiology; they may lie superficially or deeply in the lung; and ordinarily present no distinctive clinical or surgical features unless the pleura is invaded. The segmental form of pulmonary abscess is by contrast a lesion of substantial proportions which occupies much or all of the bronchopulmonary segment which had been involved by the antecedent necrosuppurative bronchopneumonia. It is with this type alone that the authors are concerned in the present communication.

Segmental aerobic (non-putrid) pulmonary abscess may be classified into three varieties: (1) abscess in the midst of, and apparently an incidental part of, an extensive area of necrosuppurative bronchopneumonia; (2) abscess as the prominent or predominating lesion, but surrounded by a considerable area of necrosuppurative bronchopneumonia; (3) typical abscess with a more or less sharply limited and narrow surrounding zone of involved lung.

Certain pathological features are common to all three varieties. They are all of substantial proportions, usually monolocular, and usually situated superficially within one of the lobes of the lung. Overlying adhesions agglutinating the opposed visceral and parietal pleuræ were found at operation in all cases. Extensive destruction of all structures, including bronchi, within the involved area is common. The clinical manifestations are essentially indistinguishable from those of the antecedent and often co-existing necrosuppurative bronchopneumonia. The diagnosis of abscess, therefore, is usually based upon roentgenography.

In the authors' experience, aerobic abscess demonstrates a tendency to subside much more frequently than anaerobic (putrid) abscess. The authors believe, therefore, that a more conservative attitude toward operative treatment is warranted for the former than for the latter. Although the authors have not as yet completely formulated their indications for operative treatment, they state that in general the results of operation have not been satisfactory, except in cases of typical abscess in which the lesion has been single, well circumscribed, and surrounded by a sharply limited and narrow zone of involved lung. In a small series of such cases, operation was followed by cure in every instance.

Methods of pre-operative localization, a description of the authors' one-stage operative technique, and details of the operative findings and postoperative treatment are included in the article.

Rienhoff, W. F., Jr.: A Two-Stage Operation for Total Pneumonectomy in the Treatment of Carcinoma of the Lung, Demonstrating a New Technique for Closure of the Bronchus. *J. Thoracic Surg.*, 1939, 8: 254.

A two-stage pneumonectomy has been devised by the author and employed in a series of 5 cases. Much of the success of his method has been attributed to the fact that the partially filled half-collapsed lung that exists following the first stage may act as a cushion which prevents extreme displacement of the mediastinal structure. An additional advantage is the interval of rest which is accorded the patient between stages, and the opportunity for adjustment to changed circulatory conditions following ligation of the pulmonary artery and the consequent gradual shifting of the mediastinum.

The author has performed his operation on 5 patients without a death. The left lung was involved in 2, and the right in 3. The ages of the patients ranged from forty-seven to sixty-seven years, and all of the patients were afflicted with a rather advanced carcinoma of the lungs. In each case the lung was found to be definitely adherent to the chest wall and the general physical condition of the patient was such that he was classified as a poor operative risk. Not one of the patients could have lived through a one-stage pneumonectomy, yet all of them survived the two-stage operation.

The pre-operative preparation of these patients consisted of the introduction of air into the pleural cavity to bring about a pre-operative collapse of the lung, if possible. Fifty cubic centimeters of beef infusion broth (hydrogen-ion concentration 7.45) containing 1 per cent peptone, have been used routinely in all cases in which it was possible to bring about a pre-operative collapse of the lung. This injection is given from forty-eight to seventy-two hours before the operation and serves a two-fold purpose, namely, it protects the patient against infection and acts as a stimulant to the formation of granulation tissue, the exudation of plasma, and the obliteration of the dead space which will result from the removal of the lung.

In the operation itself the anterior approach has been used. It has many advantages over the lateral and posterior exposures. The incision is made over the third interspace, anteriorly extending from the lateral border of the sternum to the anterior axillary line. After division of the pectoral muscles the internal intercostals are incised between the third and fourth ribs, the intercostal vessels and nerves being avoided. The pleural cavity is opened by a cut through the parietal pleura for the entire length of the incision and the opening into the chest

is very much widened by means of a self-retaining retractor or rib spreader. Complete exposure of the hilus of the lung is obtained and resection of ribs is unnecessary.

In the first stage of the operation the mediastinal pleura is incised and dissected medialward toward the underlying areolar tissue, which exposes the pulmonary artery. This vessel is then carefully freed by blunt dissection and separated from the underlying bronchus. The interior surface is dissected away from the upper border of the superior pulmonary vein, and a silk ligature is passed around the mediastinal portion of the vessel at least from 2 to 3 cm. proximal to its intrathoracic branches. Another ligature is placed about the vessel 0.5 cm. distal to the primary ligature; each ligature is then separately tied in a square knot.

The ligatures are cut at least 6 cm. long so that they may be immediately recognized at the second stage operation.

The phrenic nerve is crushed to allow temporary elevation of the diaphragm and obliteration of the thoracic cavity on that side. The primary bronchus is then stripped of all the bronchial lymphatic glands and peribronchial connective tissue and another ligature of braided white silk is placed about the bronchus high up near the trachea. This ligature is tied at the first stage. The pulmonary ligament is then divided and ligatures of double silk are loosely placed about the superior and inferior pulmonary veins, but they are not ligated at the first stage.

If this procedure is carefully followed the flow of blood through the pulmonary veins is not disturbed in any way and no moist gangrene of the lungs will result. The vagus nerve on that side is then crushed, and adhesions which may be present can be separated; but they are more safely dealt with in the second stage. The wound is then closed by drawing the ribs together, suturing the pectoral fascia with medium-sized silk sutures, and closing the skin with fine silk sutures.

The time interval elapsing between the first and second stages may be said to be about one week. Within reason it may be lengthened or shortened, but the final decision on this point remains to be determined by the future. This interval of rest between the first and second operation allows the patient to adjust his pulmonary and peripheral circulations to the changed intrathoracic conditions.

At the second stage the thoracic cavity is reopened through the incision made during the first operation. The loose ends of the ligature surrounding the pulmonary artery are located immediately and thus reveal the point of ligation of the artery. Following this the ligatures about the pulmonary vein are tied. The amputation of the hilus of the lung is then performed and no lung tissue, peribronchial tissue, nor lymph glands should be left behind. The bronchus is cut across in the mediastinum, not far from the bifurcation of the trachea and primary encircling ligature. The incision is made obliquely to the long axis of the bronchus, and in addition to that it is

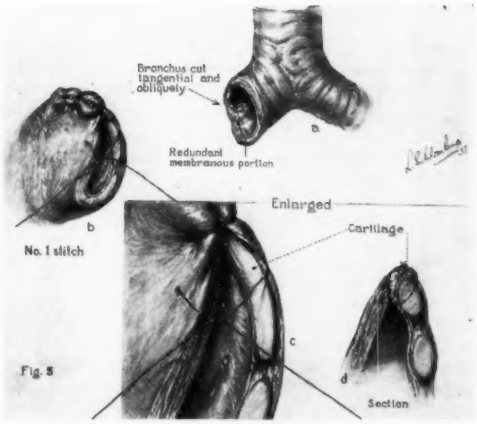

Fig. 1. The method of closure of the bronchial stump after the preliminary circumferential ligature has been placed around the bronchus and the latter ligated.

made on a bias so that the posterior membranous portion is a trifle longer than the more anterior cartilaginous wall (Fig. 1). Interrupted fine silk sutures are then placed and when they are tied and the knots pulled home, the relaxed and relatively tough membranous posterior wall is not only snugly applied or fitted to the inner surface of the semicircular cartilaginous ring at all points, but also, as a result of the way in which the sutures have been placed, the membranous portion is rolled over the cartilaginous cut edge in a way corresponding to the inversion of the intestinal wall. The cut ends of the mucous membrane are thus approximated on the inside of the blind-end stump. This tends to flatten out the horseshoe-shaped bronchial cartilage rather than constrict it, and therefore puts no tension whatever upon the suture line. Two parallel rows of through-and-through mattress sutures are placed proximal to the afore-mentioned interrupted row. These consist of No. 1 chromic catgut.

The closure of the wound after the second stage is then done in a similar manner in all respects to that following the first operation.

Following the second-stage operative procedure the inside of the thoracic cavity is completely lined with a surface of granulation tissue of considerable thickness. The decidedly shrunken cavity becomes filled with plasma, which in the absence of infection will clot and form a coagulum into which fibrous connective tissue grows from the surrounding wall of granulation tissue. After the second-stage operation this one continuous cavity will become transformed into a multilocular space comprised of walled-off pockets, the septa or walls of which are formed by the ingrowths of connective tissue. It is inadvisable to drain the thoracic cavity.

J. Daniel Willems, M.D.

HEART AND PERICARDIUM

Borchardt, M.: Chronic Calculous and Calcifying Pericarditis (Die Pericarditis chronica adhaesiva und das Panzerherz). *J. internat. de chir.*, 1939, 4: 49.

Rheumatism is today regarded as the most frequent cause of the severe cases of adhesive obliterative processes in the pericardial sac, so often uncovered unexpectedly at autopsy, and so frequently not recognized during life. Schmieden and Fischer estimate that these conditions are found in from 1 to 2 per cent of all autopsies. The author urges that unremitting efforts be made toward early diagnosis and treatment, and especially that unceasing search be made, pre-operatively and postoperatively, for foci of infection, especially in the tonsils and teeth.

Once the disease has progressed to the point where it is producing symptoms, nothing outside of surgical intervention offers any prospect of relief. This may consist in a mere paralyzing of the phrenic nerve on the left side to remove the pull of the diaphragm in accretio cordis, or Brauer's removal of the ribs over the cardiac area (cardiolysis). However, one should not conclude that accretio cordis, or adhesion of the pericardium to the surrounding structures of the mediastinum, is not present because there is no systolic indrawing of the chest wall after Delorme's intrapericardial cardiolysis, the cutting of adhesions between the heart itself and the pericardium, or the radical Rehn-Delorme cardiac decortication (pericardectomy). Also it must not be concluded that "heart-en-cuirasse" is not present because the roentgenological shadow of the heart is enlarged or because there are murmurs or other evidence of other cardiac conditions.

Results from these various operative procedures still leave much to be desired, especially those of the radical Rehn-Delorme procedure. However, one cannot very well compare the results of this procedure with the others because the other various procedures are performed for entirely different indications, the less radical being done for simple accretio cordis, or intrapericardial strands of adhesion, and the more radical for those conditions in which there is an actual immuring of the heart by the thickened, perhaps calcified, pericardium to such an extent as to interfere with the functional movements or the nutritional blood supply of one or both sides of the heart.

The author's 4 cases which were operated upon radically are reported. The patients were a girl of seventeen years, already with vitium cordis, who lived for five years following the operation; a woman of twenty-five years, who lived for five years in fairly good health after the operation; a woman of thirty-one years, who lived under intermittent medical care for cardiac breakdowns for eight years before she was lost for follow-up; and a boy of seventeen years, who has now enjoyed good health for eleven years since the operation.

Five illustrations depict the author's method of operating. JOHN W. BRENNAN, M.D.

DISRUPTION OF ABDOMINAL WOUNDS

Collective Review

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THE postoperative separation of an abdominal incision, with or without evisceration, is an accident attended by such serious potentialities that it must receive important consideration in any list of postoperative complications. It is fortunately a relatively rare occurrence, the incidence approximating 2 per cent. Many partial wound disruptions undoubtedly go unrecognized, and frequently give rise to incisional hernias. Although the major effect of this catastrophe, in many instances, is an increase in the morbidity alone, the mortality, nevertheless, is extremely high, being variously quoted from 20 to 75 per cent.

The first report of this condition in the American literature is that of Brettauer (14), made in 1899. The article describing the outstanding work of Madelung (66), in 1905, reviews the literature up to that time. Madelung found that wound disruption had been recognized since the earliest days of abdominal surgery, and reports 157 collected cases, 118 occurring in women, and 25 in men. The patients were of all ages, the youngest two days and the oldest seventy-one years. In 124 cases, the incision was below the umbilicus, and in 16 above it. The majority of the incisions were in the mid-line. The critical days were the eighth and ninth. Of the 148 cases in which the end-results were given, 43 terminated fatally. Madelung considered many causative factors: poor catgut; anemia; interference with healing of the wound caused by the stitches being too tightly drawn or too loosely placed; insufficient apposition of the layers and mass sutures; and poor closure of the peritoneum, allowing protrusion of the omentum. He believes that anything which increases the intra-abdominal pressure is also an important factor.

In 1909, Ries (89) reported 6 cases. In the same year, at a meeting of the Western Surgical and Gynecological Society in Omaha, T. C. Witherspoon (113) reported a case in which there was acute dilatation of the stomach on the eighth postoperative day. A gastrostomy was performed at that time, and when the sutures were removed preparatory to the completion of the opening into the stomach, wound healing had not taken place. There was no infection, and Witherspoon believed that this lack of healing was due to some trophic disturbance brought about by the toxic effect of abnormal fermentation of the bowel content upon the ganglionic nerve cells in the spinal segment. In discussing this paper, Charles H. Mayo (68) brought out the fact that simple abdominal distention produced an internal pressure beneath the suture line and thereby caused an anemia of the tissues about the wound with resulting interference in healing. At the same meeting, C. H. Wallace (108) stressed sepsis and constitutional dyscrasias, such as chronic nephritis and anemia, as a cause for failure of union of abdominal incisions. In 1911, Robert Morris (74) reported 4 cases of disruption, 2 cases of his own and 2 of his colleagues, and in each instance the accident had occurred following stomach operations. He states that a search of the literature in the library of the New York Academy of Medicine revealed no reference to this subject. He was of the belief that there was some trophic disturbance of the sensory nerves, as suggested by Head (41), which were related to certain superficial zones of the skin which are known to be hypersensitive in connection with irritation of different viscera. In 1912, Crandon and Ehrenfried (23) discussed the importance of sepsis in preventing the adhesion of wound edges.

In reviewing the literature on this subject, we were astonished to note the marked increase in interest during the past ten years, as evidenced by the large number of papers written upon this subject. That the true mechanism of the production of this condition in all instances still remains unknown is evident from the diversities of opinion expressed by various authors. We have attempted to determine and group what seemed to us to be the outstanding points emphasized by various authors, as taken from their individual writings. In addition, we have analyzed 33 cases of wound disruption occurring on the surgical service of the Detroit Receiving Hospital during the past five years.

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No discussion of wound disruption would be complete without consideration of the fundamental contributing factors of wound healing, proper closure of incisions, strain on suture lines, and the reaction of tissue to suture material. Of these, the most important is wound healing, a subject which has been reviewed so recently and so exhaustively by Arey (6), that it appears superfluous to enter into an extensive discussion of it here. Since it is difficult to separate the factors as regards their relation to wound disruption, we shall not attempt to discuss them as separate entities, but will relate them to the subject in appropriate places throughout this review.

It is not possible to determine the exact incidence of wound disruption. An approximation is possible, but this is likely to be none too accurate because of the small number of cases in any one report and the vagaries of sampling. Reports of wound disruptions are more likely to emanate from institutions where large numbers of cases are cared for and where established routine is customary. Smaller institutions or institutions where the number of disruptions are rare are not likely to study the incidence of wound disruptions. Incomplete disruptions or cases in which secondary closure was not carried out are frequently omitted from classification, a point which has been stressed by Meleney and Howes (71). The incidence is therefore quite likely to be estimated too low. This is true of the recorded incidence in our series of 6,532 cases in which there were 33 disruptions, an incidence of 0.5 per cent, and we believe that from 1.5 to 2 per cent would be none too high. While most authors give an incidence of from .22 to 1 per cent, higher figures are reported. The impression of Sokolov (97) that a proper figure would be approximately between 2 and 3 per cent is a viewpoint that is more in line with our estimate.

The following summary (Table I) lists the incidence of wound disruptions reported by various authors, with other pertinent data. Since this is a compilation of 1,458 cases of disruption, and in many instances the total number of cases from which these cases were taken was not given, the actual incidence in the entire group cannot be determined. Obvious separation of the wound edges which threatens the integrity of the abdominal wall is likely to be the only type of wound difficulty listed as disruption. However, any type of wound complication which does not permit of complete healing of the wound in all layers should probably be included, and if this subject were considered in this light, as suggested by many authors (70, 38, 46, 48, 17, 55, 60), the incidence would be much higher and would include all cases of incisional hernia.

It seems generally agreed that the greatest number of disruptions, statistically, occur in patients ranging in age from twenty to sixty years. Cases are reported in infants and in patients past seventy. Although it is believed that the extremes of age predispose to disruption, the reason for the difference probably lies in the fact that most surgical procedures are performed on people between the ages of twenty and sixty years. In our series, the youngest patient was twenty-five years of age and the oldest sixty-two. The greatest number of disruptions, 11, occurred in the sixth decade, and 28 occurred in the third to the sixth decades. The average age for our series was forty-six years. The average age for the entire series was forty-four years.

From our own personal observations and the majority of the reports in the literature, there would appear to be a preponderance of disruptions in the male sex, as compared to the female. This roughly bears the relation of 2 males to 1 female. However, one is struck by discrepancies in the various reports. The opinion is expressed that women have a greater inherent tendency to withstand surgical procedures (22, 72), and that men, because of various physical factors and greater muscular development, have a slight predisposition to disruption. In the earlier report by Sokolov (97) the incidence of disruptions was placed at 2 males to 1 female. Sigalas (94); Maes, Boyce, and McFetridge (67); and Bettman and Lichtenstein (12) found a greater number of disruptions in the female. The statement appears quite frequently that the incidence of occurrence is about equal in the sexes, or that the difference is of no great importance (13, 30, 61, 45). Unfortunately, many authors do not give the total number of laparotomies performed on men and women, although some, as Bettman and Lichtenstein (12), definitely state that their series contains more women than men. In our series, disruptions occurred in 21 males and 12 females, a ratio of 1.75 to 1. Gynecological laparotomies were included. Thus our ratio would tend to show a higher incidence in males than females. However, this probably does not represent the true state of affairs for the reasons pointed out before, and it is our personal opinion that, although there may be a higher incidence in the male sex, the true ratio is probably about the same in both sexes or only slightly higher in the male.

In only a few of the reviews has any special mention been made concerning a greater or lesser tendency toward disruption in various races. We

TABLE I.—SUMMARY OF 1,458 CASES OF WOUND DISRUPTION

Name	Cases	Incidence, %	Age, average	Males	Females	Malignancy	Biliary disease	Appendicitis	Ulcer	Ileus	Gyn. & obst.	Miscellaneous	Upper incision	Lower incision	Drainage	Infection	Disruption day	Deaths	Mortality %	Total number of laparotomies
Brettauer	3	—	41	0	3	0	0	0	0	0	3	0	0	3	0	—	6.0	2	67.0	—
Madelung	157	—	42	25	118	21	0	2	1	—	80	53	16	124	—	—	8.5	35	23.0	—
Ries	6	—	40	2	4	2	0	1	0	0	2	1	2	4	0	—	8.5	1	17.0	—
Shipley	5	—	—	5	0	1	1	0	0	1	0	2	3	2	—	—	9.6	0	0.0	—
Gusnar, von	11	.41	55	11	0	5	1	0	2	1	0	2	9	2	2	4	11.3	8	73.0	—
Horner	3	.30	34	0	3	0	0	0	0	0	3	0	0	3	0	0	7.3	0	0.0	1010
Monod & Kiraly	6	—	43	1	4	1	0	0	1	0	2	2	3	3	0	0	10.0	0	0.0	—
Sigalas	8	—	43	3	5	1	0	1	0	0	5	1	2	6	2	1	9.8	1	14.0	—
Sokolov	723	2–3	43	407	239	169	63	29	120	57	94	191	229	67	49	93	8.4	226	34.0	—
McCauliff	3	—	49	2	1	1	0	1	0	0	1	0	1	1	0	0	8.3	0	0.0	—
Starr & Nason	15	.61	47	—	—	5	2	3	0	1	4	0	6	9	—	—	—	—	—	2455
Eliason & McLaughlin	25	.27	—	19	6	6	6	1	11	—	0	1	22	3	8	6	6.1	8	32.0	9155
Meleney & Howes	56	1.00	51	41	15	19	16	6	5	3	1	6	35	17	29	35	7.5	30	54.0	—
Colp	29	.90	42	14	12	8	7	5	0	—	5	4	10	14	13	—	—	8	28.0	2750
Grace	46	—	—	—	—	10	8	7	11	2	0	8	39	7	—	17	7.6	18	39.0	—
White	33	—	46	23	10	6	6	3	9	2	0	7	19	12	10	10	8.7	18	55.0	2145
Heyd	8	.25	—	—	—	—	—	—	—	—	—	8	—	—	—	—	—	2	25.0	—
Maes, Boyce & McFetridge	44	—	32	21	23	5	2	10	1	3	8	15	11	33	10	0	—	13	30.0	—
Koster & Kasman	17	.22	49	13	4	2	4	5	4	0	1	1	10	6	7	6	7.8	3	18.0	7892
Milbert	20	1.30	53	17	3	8	7	0	3	0	2	0	13	3	9	7	8.3	11	55.0	1560
Glasser	8	.24	48	6	2	0	2	0	3	0	1	2	7	1	4	3	8.8	5	63.0	3224
Bettman & Lichtenstein	32	.43	44	10	22	6	6	1	2	4	13	0	11	21	3	4	7.9	12	38.0	7500
Jenkins	36	—	56	28	8	19	7	2	3	1	0	4	26	9	7	13	9.0	13	36.0	—
Boland	12	.28	30	7	5	1	1	2	0	5	3	0	4	8	2	3	—	8	66.7	4337
Glenn & Moore	22	.75	—	20	2	6	8	1	1	3	0	3	14	7	8	5	8.0	10	45.0	2927
Fallis	50	.64	43.3	27	22	8	10	8	3	28	14	0	26	23	19	10	7.6	17	34.0	7903
Totten	47	.24	—	33	14	7	2	4	6	4	5	19	21	12	—	17	6.5	19	40.0	19473
Hartzell & Winfield	33	.50	46	21	12	3	3	5	9	3	6	4	20	12	10	9	8.3	14	42.4	6532
Total	1458			756	537	320	162	97	195	118	253	334	559	512	192	252		482		78,863
Average or %		1.83	43.7	58.5	41.5	22.0	11.1	6.6	13.4	8.1	17.4	22.9					8.24		34.8	

This table originally compiled by Jenkins (50) contained 1,294 cases. We have added the last 5 reviews comprising 164 additional cases. "The averages or percentages given in the table, were calculated on the basis of the number of cases in which the data for that column was available. This did not correspond with the total number of cases reported in each instance (50)." The average or percentage given in the incidence, age, average disruption day, and mortality per cent columns are weighted values.

have been unable to arrive at a definite opinion as to whether or not wound disruptions occur more frequently in any one race as compared to another. In our series, the incidence in the Negro race was 24.3 per cent, 8 cases, as compared to the incidence in the white race of 75.8 per cent, 25 cases. This indicates a slightly higher incidence in the Negro race, since our usual hospital proportion of Negro to white patients is normally 1 to 4. However, Maes, Boyce, and McFetridge (67) stated that the incidence in the Negro race was slightly smaller than in the white race. Boland (13) likewise reported a lower incidence in the colored race, .28 per cent, and concludes that a possible explanation may be found in the tendency to keloid scar formation. The difference in incidence between the white and colored race is very slight, and it is questionable whether this

difference is real. We have been unable to find any definite reference to variations in incidence in wound disruption in other races, with the possible exception of a notation by Sokolov (97), who states that disruption is more often seen in northern people during winter and spring. This indicates, however, that this observation may be based on a possible seasonal variation, a finding which he attributes to lack of Vitamin C in the diets of northern people in the winter. Our highest incidence occurred in the months of March, November, and December, 5 cases for each month. From November to April there were 20 disruptions, as compared to 13 for the period from May to October. This might suggest that respiratory diseases favor this complication, and this suggestion might find weight on the basis that respiratory diseases produce coughing and restlessness, or slightly lower the patient's vitality, and thus play a rôle in wound disruption. However, the difficulty in making such a comparison is great, since the seasonal variation of respiratory complication following operative procedures is not a very clear-cut one (86). While most writers on the subject of wound disruption make no reference to seasonal variations, Fallis (30) noted a much higher incidence in March, April, and May; Colp (22) could find no seasonal relationship; and Rakhman (85), and Maes, Boyce, and McFetridge (67) believe it has no bearing on the subject.

The exact evaluation of the importance of individual disease, the patient's general condition, and other factors attributable to the patient in the production of wound disruption is difficult. Certain it is that a patient in poor condition before, during, or after an operation will fall in the class of potential wound-disruption cases. Any factor which interferes with normal wound healing is naturally of great importance. Debilitating diseases causing anemia and cachexia (97, 3, 70, 72, 22, 34, 111, 42, 85, 78, 48), Vitamin-C deficiency (115, 5, 114, 44, 116, 51, 101, 64, 63, 97), hypoproteinemia (102, 103, 39, 79, 2, 90), and allergy (7, 46, 52, 59, 112, 30, 111) have been stressed frequently as predisposing toward wound disruption.

In our series wound disruption occurred most frequently (6 times) in the ruptured peptic-ulcer cases. This is not remarkable when one considers: (1) the patient's pre-operative condition (2 bad risks, 2 fair risks, 1 good risk); (2) the potentiality for infection; (3) the possibility of a stormy postoperative course. A very considerable number of ruptured ulcer cases come to our hospital, averaging 35 to 40 a year. The next greatest number of disruptions occurred in cases of gunshot wounds of the abdomen (2 of the patients were in a critical condition before operation, 1 in fair condition, and 1 in good condition). In only 3 cases was malignancy the primary disease. Myoma of the uterus was the disease in 3 cases, and in 2 more cases this was associated with another underlying pathological condition. Eleven of these patients were in a poor or critical condition, 2 were in a fair condition, and 10 were in a good condition. Nine patients had a definite anemia, either preoperative or postoperative; only 3 had positive Kahn reactions.

It will be seen that in many of these cases the general condition was such that one might have expected a higher incidence of disruption than the average. All of the patients were quite ill or had a previously co-existing general disease, anemia being an important factor. The cases of reported ulcers were, by and large, cases in which dietary régime had been deficient, and as a rule these patients were not properly nourished. It is quite surprising that there was but a small group of cases in which cancer was the factor. Malignancy has been emphasized by a majority of writers on this subject, and comprises 22 per cent of the diseases associated with wound disruption in the total of the reported series. In addition to gastric and duodenal diseases, uterine fibroids and biliary diseases figure prominently in the list of primary diseases. A shocking surgical procedure or a complicated and stormy postoperative course in a patient who is quite ill may likewise predispose to wound diaster. Recently there has been much concern about Vitamin-C deficiency, chiefly with respect to sub-clinical levels of this vitamin. Naturally, the concept of Vitamin-C deficiency with regard to difficulties in wound healing is not new.

Richard Walter's account of Lord Anson's "Voyage Around the World" (107), in 1740, vividly describes the effects of scurvy among the crew: "scars of wounds that had been for many years healed, were forced open—one of the invalids—who had been wounded fifty years before—and had continued well for a great number of years past, yet, on his being attacked by the scurvy, his wounds in the progress of the disease broke out afresh, and appeared as though they had never been healed."

Wolbach and Howes (115) demonstrated that the histological basis for the failure of wounds to heal in the presence of a Vitamin-C deficiency lies in the inability of the supporting tissues to produce and maintain intracellular cement substance. Archer and Graham (5) believe that many patients with gastric disease are in a subscurvy

state owing to long periods of ill health and restricted diet. They have observed that wounds heal badly in these patients. Hess (44) agrees with these observations. Wolbach (114) sums up the picture of Vitamin-C deficiency as related to wound healing as follows: in general, the pathological picture "is produced by resorption of intracellular materials in growth and reparative reactions." He states further that "histologic repair, following the administration of vitamin C in natural foods or as cevitamic acid, is dramatic in character and promptness;" within twenty-four hours all normal processes of repair are resumed.

Youmans (116) believes that, although frank scurvy is rare, in contrast, mild or latent scurvy or a slight deficiency in Vitamin C is probably very common. Ingalls and Warren (51) report 20 cases of peptic ulcer, in all of which there were low Vitamin-C values. They believe that there is an important relationship between low Vitamin-C values and the inability of an ulcer to heal and its tendency to bleed. Therefore, they urge a check of the Vitamin C of the blood plasma before such cases are subjected to surgery. Taffel and Harvey (101) report that the tensile strength of stomach wounds in the partially scorbutic guinea pig is markedly decreased from the eighth to the tenth days. Lanman and Ingalls (64) have shown that guinea pigs maintained on approximately one-fifth of the minimal preventive dose of ascorbic acid exhibited healing of operative incisions inferior to that of normal controls. Lanman (63) says asymptomatic scurvy is far more common in infants and children than is realized, and presents evidence to show that a partial Vitamin-C deficiency is of more importance in the healing of surgical wounds in human beings than has hitherto been realized. Sokolov (97) recommends a diet rich in Vitamin C and considers partial Vitamin-C deficiency to be a definite factor in poor wound healing.

The effect of low serum protein upon wound healing has been studied by many investigators. A recent paper by Thompson, Ravdin, and Frank (102) aptly summarizes this phase of the subject. "Clark (18) showed that on a diet high in protein there was no quiescent period in the repair of the wound in his dogs, the contraction beginning at once. In the review of Arey (6) on 'Wound Repair,' one is struck with the fact that many of the factors associated with repair are directly or indirectly dependent on a diet high in protein. Thus, animals fed on a diet of this type showed accelerated fibroblastic proliferation (39). Cellular activity on the whole, greatly increased (11). The quantity of secretion from the wound was decreased (91). A diet high in carbohydrate, to which alkalis have been added, increased the quantity of this secretion (91). The wounds of animals on an alkaline diet are said to be more easily infected (43).

"Thus, there are a number of factors both in the dog, and in the patient who is subjected to a prolonged and serious protein deficiency, which favors disruption of the wound. It has been observed that, when cultures of growing cells are surrounded by an overabundance of fluid of low viscosity, cell motility is retarded. Our experiments would tend to support the theory that certain of the amino-acids are essential for the stimulating of tissue growth (79, 2, 90)."

These authors (102) found that in a high percentage of dogs with well advanced hypoproteinemia, evisceration or breakdown of the wound will occur after laparotomy. Thompson, Ravdin, Rhoads and Frank (103) found further that catgut loses its tensile strength more rapidly in the presence of hypoproteinemia, and also that they could restore serum protein to normal in hypoproteinemic dogs by means of intravenous injections of lyophile plasma, and in these animals the wound healed normally. Whipple and Elliott (111) and Stone (100) also believe hypoproteinemia is a factor in the production of wound disruption.

The possibility that the sensitivity of the patient to catgut suture material may have some bearing on wound healing has been investigated by many observers. Babcock (7) considered that both the edema and serosanguineous discharge which follow thyroidectomy when catgut is used were due to sensitivity to catgut. When silk was substituted for catgut in thyroidectomies, these reactions were eliminated. Hinton (46) observed that catgut suture material frequently disappeared from the clean disrupted wound. He pointed out that this rapid absorption could be an allergic reaction. Jenkins (52) stated "when absorbable suture is used, the rapidity of digestion of the approximating suture material should be considered a factor of significance." Kraissl, Kesten, and Cimotti (59), in a recent experimental and clinical investigation upon this subject, demonstrated that guinea pigs may be sensitized to catgut, which if again introduced caused a marked local reaction. This frequently resulted in a rapid absorption of catgut from the wound. They performed skin tests upon 332 patients and obtained a positive reaction in 14.15 per cent. This incidence greatly increased with a history of allergy or of a previous operation. They suggest that when catgut is used, this factor of wound disruption may be eliminated by testing patients

pre-operatively, thereby decreasing the incidence of wound disruption. White (112), Fallis (30), and Whipple and Elliott (111) likewise considered allergy a factor.

Many other conditions, specific and otherwise, have been reported as predisposing to disruption. Obesity (36), phlebitis (25, 26), and diabetes (93) are among the many conditions which are presumed to presage a high incidence of wound disruption. These conditions apparently are not important in themselves, but are only of importance as they affect wound healing in general. The presence of syphilis has been mentioned by several writers (34, 12, 13), who believe it has little relationship to wound disruption.

The influence of the type and position of the incision is generally considered of great importance in the matter of wound disruption. However, it is difficult to evaluate the importance of these factors as related to wound healing. The greater number of disruptions occur in upper abdominal vertical incisions, particularly of the rectus-splitting type. In the majority of the surveys which have been made, this has been the incision most commonly used, and, therefore, most likely to disrupt, on the basis of its most frequent use. Also, upper abdominal incisions are more likely to be used in the presence of serious illnesses. In our own series, the majority of disruptions occurred in vertical incisions of one type or another, and the majority of these were in the upper abdomen. The actual data regarding the position and type of incision in our 33 cases were as follows: upper abdominal vertical incisions, 18 cases; mid-abdominal vertical incisions, 4 cases; lower vertical incisions, 9 cases; there was 1 drained McBurney incision and 1 subcostal incision. Thus, a great preponderance followed vertical incisions, most marked in the upper abdomen. These figures are in general accord with the majority of reported series (112, 38, 70, 28, 57, 34, 33, 72, 104). There are but few writers who consider the type of incision of little importance (45, 61, 99). In surgical lesions of the abdomen, it is difficult to arrive at a definite evaluation of the various incisions; however, we feel that the evidence tends to militate against vertical abdominal incisions, and, therefore, urge the use of transverse and oblique-muscle and fascia-splitting incisions whenever possible. During the past two years, on the general surgical service at Receiving Hospital, it has been our practice to use the muscle-splitting incision of gridiron or McBurney type in practically all cases of appendicitis, or in any other condition where it is feasible. In addition, we have been employing, in the past year, a small transverse upper-abdominal incision, as described by Amendola (4), when operating upon ruptured peptic-ulcer cases. Also, we usually use the subcostal or Kocher (56) incision in biliary surgery. To date none of the small transverse incisions have disrupted. It is our opinion that the small upper right transverse incision, as used for ruptured ulcer cases, is a definite advantage, not because disruption may not occur, but if it does there is far less likelihood of evisceration. During the past two years, we have become more and more inclined to the use of transverse or muscle-splitting abdominal incisions, and it is gratifying to note that not a single case of disruption has occurred in this group of cases.

Batson (10) has shown that, anatomically, the transverse incision for upper abdominal surgery possesses certain advantages in preserving the nerve and blood supply (Fig. 1). There is another factor which favors the transverse incision in upper abdominal surgery which is frequently overlooked, namely, the preservation of the transversalis muscle. Sloan (96), Singleton (95), and Clute (20) emphasize the importance of this structure. When the muscle is severed in vertical upper-abdominal incisions, it tends to pull the peritoneal layer apart and thus allows a tab of omentum or knuckle of bowel to protrude through the muscle layer (Freeman's Theory) (32). Clute (20) believes that the peritoneum and transversalis muscle should be sutured with interrupted mattress sutures (Fig. 2). Whipple and Elliott (111) recognize the importance of the lateral pull of the oblique and transversalis muscles in the vertical incision, and stress the importance of a careful, secure closure of the peritoneal layer (See illustration described under technique). This fact is further stressed by Shipley (92) who states: "A very important thing is the transverse direction of the deeper layers of the abdominal wall giving poor support to the suture line of a vertical incision." This fact has also been recognized by Pool (82), who stressed the importance of suture of the posterior sheath, and also by Lynn (65), DeMuth (24), Meleney and Howes (71), and others.

Writers who stress the advantages of vertical incisions frequently emphasize the value of not splitting the rectus muscle, and of retracting it laterally so as to preserve the nerve and blood supply (53, 77). Rarely, however, is mention made of the disadvantage of this incision; namely, the severance of the transversalis muscle. In 1913 Quain (84) wrote: "All those who have made a number of gallbladder operations through longitudinal incisions in tense abdominal walls, will remember instances when it seemed impossible to

Fig. 1. Batson's (10) dissection to show the nerve supply and the sheath of the rectus muscle. The continuation of the fleshy fibers of the transversus abdominus muscle behind the aponeurotic sheath is shown. In a less well muscled individual, these appear as a fascial plane. (*Surgery*, 1938, 3: 871).

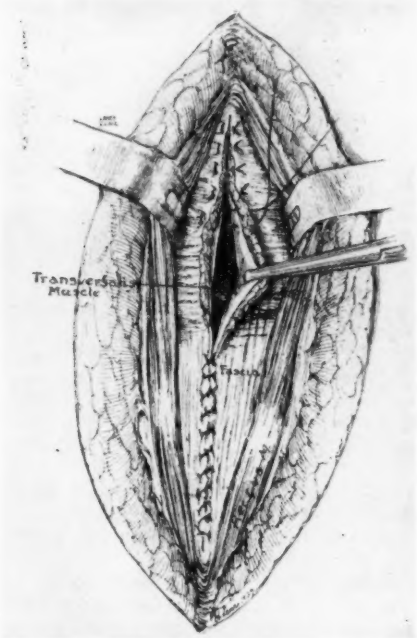

Fig. 2. Clute (20) stresses the importance of placing mattress sutures through the transversalis muscle, fascia, and peritoneum, to take the strain of the transversalis pull in postoperative vomiting and moving. (*Surg. Clin. North Am.*, 1929, 9: 1403.)

make a satisfactory serosa to serosa closure of the peritoneum, because of the lateral pull of the so-called posterior sheath of the rectus muscle. Sometimes the suture would cut through the peritoneal margin again and again, until there was no hope of making a smooth closure of the frayed edges. Finally a few stitches were probably placed far out into the rectus muscle, in a desperate but vain effort to overcome the difficulty, and to have no raw surface facing the viscera.

"In the hands of many operators, this manner of opening the abdomen is chosen solely because of its fancied convenience to the operator, and without due consideration of the fact that in every longitudinal, transrectus, or para rectus incision, irreparable damage may be inflicted on the patient."

Many writers state that the length of the incision is of little consequence, and quote the old adage that incisions heal from the side and not from the end. Sloan (96) states, however, that the danger of hernia with longitudinal incision increases in proportion to the square of the length of the incision. He has devised an incision which splits the anterior rectus vertically (Fig. 3), and the transversalis fascia transversely (Fig. 4), somewhat after the principle of McArthur (69). He states that this is easily closed, even in the absence of abdominal relaxation, and that the danger of wound separation is almost entirely eliminated. Many authors have stressed the advantages of the transverse incision for upper abdominal surgery (98, 76, 31). Singleton (95) also describes an excellent transverse incision in which the rectus is retracted medially, and the posterior sheath of the rectus and the peritoneum are then cut in the direction of the fibers of the internal oblique and transversalis muscles. Glenn and Moore (34) state: ". . . the mid left rectus and transverse rectus incisions are rightfully used with great reserve, for the incidence of evisceration in both is very high." However, their conclusion regarding the transverse-rectus incision is based on a single case.

When making a low midline incision, Horner (48) believes that a stronger closure may be obtained by following the method of DeLee: cutting

the structures at different distances from the midline, thereby staggering the incisions in different layers so that no structure is opened in the plane of the one immediately above it. Even when the entire incision is in the same plane, it is possible to overlap the edges to get the same effect as cutting in different planes. This is confirmed by Morton (75). Sloan (96) advises a transverse incision, on the order of that described by Pfannenstiel (80), to eliminate the dangers of postoperative hernia and wound separation.

The technique, method, and type of material used in primary wound closures has been a subject of much discussion in recent years. There are those who believe that absorbable suture material is the material of choice, and generally the cause for this choice lies in the fear of infection and foreign-body reaction in the wound, which tend toward subsequent abscess and sinus formation. While this may be a troublesome complication, those in favor of non-absorbable suture material, such as silk, base their contention of its superiority on the basis of its greater and more persistent tensile strength with a much smaller volume of suture material (111, 106).

Occasionally in cases of wound disruption, in wounds closed with catgut, it has been impossible to find any evidence whatsoever of suture material in the wound. This is frequently so striking, despite the fact that it might be difficult to find the catgut, even though it were there, that we feel the reported absence of catgut is a reality. This rapid absorption of catgut has been attributed to catgut allergy, but it is well known from the work of Howes (49), Rhoads, Hottenstein, and Hudson (88), and Jenkins (52) that the tensile strength of both plain and chromicized catgut, irrespective of size, decreases rapidly and decreases even more rapidly in the presence of blood serum (45, 57, 13, 50, 62, 37), or inflammatory exudate. Howes (49) believes that if the presence of serum or infection can be foreseen, a removable non-absorbable suture should be used in closure of the wound. Kraissl (58) has observed further that the presence of intestinal ferments hastens the absorption of both plain and chromic catgut. Also, he noted that there are certain intrinsic factors which result in the loss of tensile strength. Certain brands of catgut contain foreign bodies and flaws which appear to be due to splicing. The rate of absorbability of catgut is to some extent dependent on the age of the animal from which the catgut is prepared, according to Trout (105).

Those who are adherents of silk technique stress the great care that is necessary in the closure of clean cases. Other suture material has been suggested because of the minimal amount of reaction brought about in the tissue. Chief of these are fine stainless steel wire, as proposed by Babcock (7), and a newer substance made from plastics, as suggested by Collins and Bellas (21). A study of the literature with regard to the incidence of wound disruption following the use of various suture material reveals no data of value. In one series reported by Glenn and Moore (34), in which layer suture of silk was used, there were 7 disruptions in 1,144 cases, an incidence not particularly different from that reported by other authors in cases in which catgut undoubtedly was used. In 1905 Madelung (66) stated in his review that the employment of any one type of suture material was not proof against wound disruption. Other authors concur in this opinion (94, 42, 12), which seems to us to be axiomatic, as wounds heal across the line of incision and not by means of sutures. The suture material is placed to approximate tissues rather than to bind them. The advocates of the use of silk (111, 71, 34) stress careful handling of the tissues, the use of the finest and highest grade of silk, the careful approximation of tissues without tension, and the avoidance of strangulation of large masses of tissues. These factors in themselves appear important to us, not only in aiding primary union, but in the prevention of infection as well. Accordingly, Maes, Boyce, and McFetridge (67) believe that catgut, as used by Howes (49) with "silk technique," is probably as safe as silk, and question the general use of silk in wound closures. The use of silk in infected cases is viewed with disfavor (71, 34, 111), and the use of catgut and silk buried in the same wound is not good practice (111). Unquestionably, the reaction of tissues to large strands of catgut is much greater than that found about silk sutures ordinarily used, and the use of both types of sutures together has a tendency to provide for a prolonged marked reaction in the wound. Nisnevich (78) reported 8 cases of disruption, all of which were closed with mixed catgut and silk sutures. The use of through-and-through silver-wire sutures, after the manner of Reid, Zinninger, and Merrell (87), is advised by several authors in selected cases (34, 67). One writer, Kennedy (54), reports 30,000 laparotomies closed without attention to approximation of the layers with heavy non-absorbable material, without a single disruption. This is a striking record, and these results are difficult to evaluate on the basis of modern concepts and experiences in wound healing.

In this series, 16 cases of disruption had been closed in layers with continuous plain No. 1 cat-

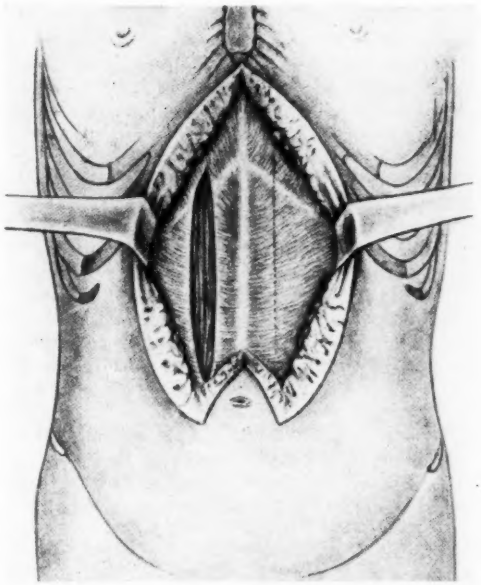

Fig. 3. Sloan (94) makes a midline incision through the skin, and vertical incisions through the external sheaths of the recti about 1 cm. external to their inner borders. The amount of exposure will depend upon the length of these two incisions. (*Surg., Gynec. & Obst.*, 1927, 45: 678.)

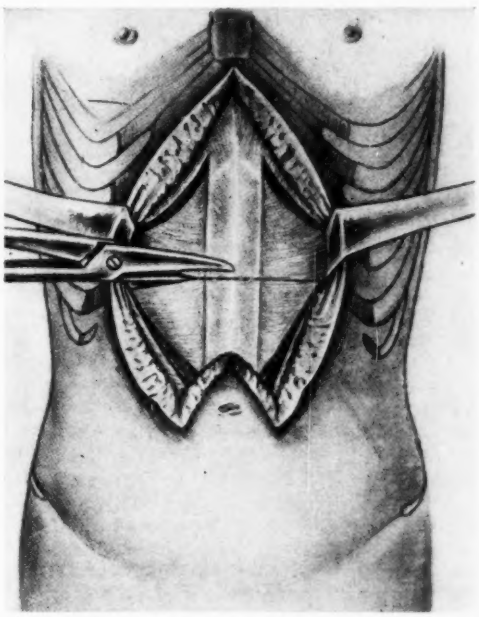

Fig. 4. After the retractors are in place and the posterior sheaths of the recti are exposed, a transverse incision is made through the posterior sheath and peritoneum, as shown here. (*Surg., Gynec. & Obst.*, 1927, 45: 678.)

gut doubled for the peritoneum and posterior fascia, continuous chromic catgut No. 2 doubled for the fascia, and silk-worm gut tension sutures through the skin, muscle, and fascia. Ten cases had been closed with continuous plain No. 1 catgut doubled for the peritoneum and posterior fascia, interrupted chromic catgut No. 2 for the fascia, and silk-worm gut tension sutures, as above. Continuous chromic catgut No. 2 for the peritoneum and posterior fascia, interrupted chromic catgut No. 2 for the fascia, and steel-wire tension sutures were used in 3 cases. In 2 cases continuous plain catgut No. 2 was used for the peritoneum and posterior fascia, interrupted chromic catgut No. 2 for the fascia and no tension sutures. One case was closed with interrupted silk for the peritoneum, continuous silk for the fascia, and no tension sutures. Continuous plain No. 1 catgut was used for the peritoneum, and through-and-through silk-worm gut sutures were used in 1 case.

As can be seen, 6 different methods of closure were used in the 33 cases of disruption. Over the five-year period, numerous surgeons were performing operations. At the present time, we are adopting a more definite general policy in the technique of closure, which may be summed up as follows:

1. For clean cases, fine grade continuous silk for the peritoneum and posterior fascia, interrupted silk for the anterior fascia, and steel-alloy-wire tension sutures, sometimes through and sometimes down to the peritoneum.

2. For infected cases, continuous No. 1 chromic catgut[1] for the peritoneum and posterior fascia, interrupted No. 1 chromic catgut for the fascia, and steel-alloy-wire tension sutures, as above. We have used through-and-through steel or silver wire interrupted sutures occasionally in badly infected cases, or in those in which disruption was feared, and are considering their wider use, but we cannot accurately evaluate this method at the present time.

It must be appreciated that although the majority of cases in any reported series may have been primarily closed by a definite method, with definite suture material, there is no indication

[1] As this paper goes to press a brand of No. 00 and No. 000 chromic catgut has been brought to our attention. We have tried this in a few cases and are impressed by its excellent tensile strength and apparent lack of irritating qualities.

that this is the method and material of choice of the author, especially since in many instances the author has used cases for his study which were operated upon by many other surgeons. This has been the case in the series we have reported.

Exact coaptation of the structures, especially the peritoneum, is important (32), since a wedge of omentum or other intra-abdominal content may prevent healing of the peritoneal layer. The importance of careful closure of the peritoneum cannot be too strongly stressed, and many authors have taken the trouble to go into detail about this matter (3, 48, 15, 55, 99, 45, 13, 60, 104, 71, 72, 28). Clute (19, 20), especially, stresses this point in the closure of upper abdominal incisions, and in addition is careful to secure accurate approximation of the transversalis muscle and fascia, which he closes with the peritoneum as one layer, by means of interrupted mattress sutures (Fig. 2). The use of tension sutures frequently affords protection against evisceration should disruption occur. Their primary purpose is to relieve tension on the suture line at the edges of the incision. It is very doubtful whether they do this except under the stress of coughing and moving about. If used, tension sutures should be of material which causes very little reaction in the tissues. We have found the use of stainless steel wire best suited for this purpose. In healthy individuals in whom good wound healing is to be expected, it is not likely that they would be of great advantage. In cases in which disruptions are likely to occur because of debility, infection, or severe stress upon the wound, they may give comfort to the surgeon.

Whipple and Elliott (111) believe tension sutures are unnecessary and sometimes result in infection, and they advise against their use. However, they advocate what amounts to a buried tension suture, the "far and near" stitch. They advise closure of the peritoneum, posterior rectus sheath, or transversalis fascia, with continuous suture of fine silk reinforced at 2 cm. intervals with interrupted silk sutures. The "far and near stitch" is an interrupted stitch of fine silk (Fig. 5) and is placed in anterior rectus fascia. In our own work, we are inclined to use fine silk, treated to diminish porosity, in all clean cases, with careful attention to approximation in layers. In contaminated or infected cases, we use a No. 1 catgut, employing the silk technique. We are not adverse to placing tension sutures of fine stainless steel through the layers of the abdominal wall to the peritoneum for added safety in cases in which we suspect there may be difficulty with the integrity of the wound. It is only occasionally that we resort to the use of buried stainless steel wire, and this chiefly in the repair of large ventral hernias. In no instance have we found any undue reaction to this material, and in none of the cases have we had a disruption. However, the number of cases so treated have been small.

It should be stated here that an efficient and smooth anesthetic is an important factor in obtaining a satisfactory closure with a minimum of trauma (45, 13, 99, 57, 40, 104). Some writers deplore arresting the anesthesia too soon, and the too energetic use of carbon dioxide at the close of the operation to prevent atelectasis.

We believe that drainage through the operative wound probably favors to some extent the production of wound disruption, by increasing the incidence of wound infection and by allowing the protrusion of omentum or intestines into the depths of the wound about the drain. This is in agreement with the opinion held by Maes, Boyce, and McFetridge (67), and Jenkins (52). Certain authors specifically stress this latter point (13, 104, 67). If we assume that the majority of the total number of cases operated upon probably were not drained, the reported number of drained cases which disrupted assumes considerable importance. This consideration is mentioned by Meleney and Howes (71). In our series, 10 of the 33 cases were drained, 2 through a stab wound with no drains in the major incision. It would seem logical, when possible, to use stab-wound drainage at some distance from the operative incision (33, 30, 52). When it is necessary to bring a drain out through an operative incision which has been closed in layers, we believe it best to approximate the wound margins with interrupted sutures about the drain, and not rely on a running or continuous suture.

Postoperative complications which tend to increase intra-abdominal pressure, such as respiratory lesions with coughing, vomiting, undue straining, and distention, play an important part in wound disruption. However, it must be understood that all cases which disrupt do not necessarily have a postoperative complication of the afore-mentioned types. In our series, 10 patients had respiratory complications, 3 suffered from distention, 1 had ascites, 1 had disruption following gastric lavage, and 1 sat up on the third day to void. Thus it is probable that in 16 of our 33 cases, increased intra-abdominal pressure may have been an attributable cause. In this conjunction, we believe that the use of duodenal suction, as proposed by Wangensteen (109), and small intestinal intubation, as introduced by

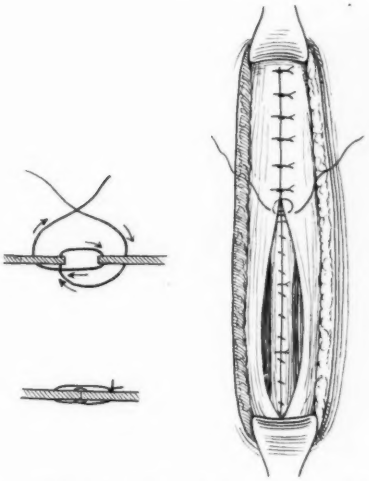

Fig. 5. Whipple and Elliott's (111) method of fine-silk closure of a clean abdominal incision. The peritoneum is closed with a continuous fine-silk suture, and is then reinforced every 2 cm. with interrupted silk sutures. The fascia is then closed with the "far and near" stitch. (*Ann. Surg.*, 1938, 108: 741.)

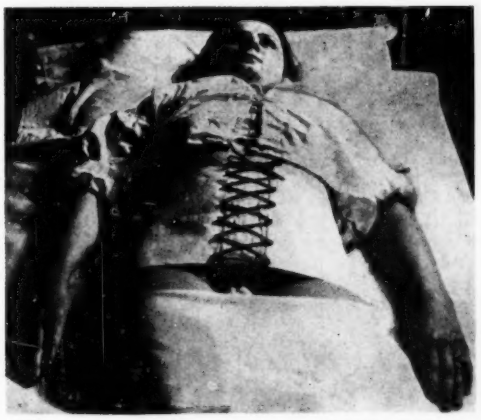

Fig. 6. Horner (46) advises the use of an efficient abdominal support in the form of an adhesive corset. The one illustrated permits of frequent inspection of the incision. (*J. Am. M. Ass.*, 1929, 90: 1126.)

Abbott and Johnston (1), will obviate most of the mechanism and danger from increased intra-abdominal pressure due to intestinal distention. It has been pointed out by Horner (48) and Meleney and Howes (71) that hiccough, vomiting, and distention may not only cause disruption, but they may be present as a result of an unrecognized partial obstruction, while Bettman and Lichtenstein (12) state that coughing and vomiting are of relatively little importance. Many authors (48, 94, 99, 8, 24, 42, 40, 33) stress the value of an efficient abdominal support (Fig. 6). In summing up the general opinions in the literature, it may be said that conditions increasing the intra-abdominal pressure (72, 57, 104, 76, 27, 13, 33, 22, 99, 67, 66, 97, 112, 35, 85, 9, 29, 78) in the main probably act as contributory factors and occasionally as causal factors in the disruption of wounds.

The importance of infection is somewhat debatable, but it is our belief that it must be considered as a contributing factor and, in some instances, an exciting factor in the disruption of wounds. The expressed or implied viewpoints of various authors concur with the above opinion (97, 3, 85, 112, 111, 28, 99, 35, 19). It is easily understood how gross infection could materially affect wound healing, as there is an increase in the exudative period, a delay in the reparative stage, and an increase in the rapidity of absorption of catgut (28, 72, 48, 60, 71, 13, 52, 104, 50). On the other hand, there are cases which show no signs of gross infection which disrupt; but it has been pointed out by Meleney and Howes (71) and Sigalas (94) that there are a considerable number of these cases which are in reality contaminated. In our series, 16 of the 33 cases of disruption were infected. Although 4 other cases which were potentially infected disrupted, no gross infection could be demonstrated. In 1 of the latter cases the patient had undergone a posterior gastrojejunostomy. One patient had a gunshot wound of the duodenum and ileum, 1 had a perforation of the transverse colon, and 1 had a stab wound of the abdomen with evisceration of the bowel through the wound. Thus our total of contaminated and infected cases would be 20 out of 33 cases.

Bettman and Lichtenstein (12), Glasser (33), and Colp (22) believe that infection cannot be considered as a major factor in disruption. Maes, Boyce, and McFetridge (67) point out that the importance of infection is debatable and disputed, and also that only a relatively small number of the total of infected wounds disrupt. In the presence of infection, disruption of the abdominal wound seems to be attended by a higher mortality (3, 70), although it must be understood that the underlying pathological condition, such as peritonitis, may materially affect this evaluation.

In any case in which there is fear of a wound disruption, particular attention must be given to

the signs and symptoms of this disaster. This is of particular importance during the period from the fifth to the tenth postoperative day. Twenty-six of our 33 cases presented disruption from the fifth to the ninth day; the average time was eight days. Disruption of abdominal wounds has been observed as early as the first day (34, 13), and as late as the sixtieth day. The majority of these accidents, however, occur from the fifth to the tenth postoperative day, the eighth day being the average (66, 97, 33, 72, 112, 28, 89). The occurrence of disruption shortly following the removal of tension sutures has been noted by several authors (94, 45, 67, 83).

The importance of recognition of an impending disruption or an actual disruption in its early stage seems obvious, as repair can be performed with less possibility of contamination of the wound (36), the degree of shock is lessened, and the hazard of intestinal obstruction is reduced. Usually there will be a serosanguineous discharge from the wound (67, 112, 22, 72, 33, 57, 30, 92, 104, 16, 29), and this was noted in 20 per cent of our cases; but it is our opinion that if this sign was looked for conscientiously, the percentage would be higher. Any edema or fluctuation along the line of skin incision should immediately arouse suspicion. If the patient complains of a sudden sharp pain in the region of the wound, or during a fit of coughing or vomiting feels something "give way" (22), then the possibility of an impending disruption must be considered. Unfortunately, the symptoms may be so mild as to draw little attention to the wound. If a deep separation is suspected, it is sometimes of value to probe the wound under aseptic precautions, as suggested by Lahey (62) and Clute (19). Signs of partial intestinal obstruction (99, 22), as evidenced by persistent nausea, vomiting, or distention (57, 71) may be present. Thus it is evident that although impending or partial disruption may not always be definitely diagnosed, every effort should be made to recognize this condition and proceed with early and efficient treatment.

When a wound disruption is discovered, it should be the duty of the surgeon to take immediate precautions to guard against evisceration, or if there is protrusion of the viscera, further prolapse should be prevented by the application of sterile dressings and external pressure with the hand or with adhesive strapping. The importance of this procedure, which of course should be done regardless of what further methods of treatment are to be used, has been emphasized by Madelung (66). It seems logical to agree with the statement of Von Graff (36), that the sooner the disruption is recognized and proper treatment instituted, the better the chances of a favorable outcome. If the patient's condition will permit, following the administration of a reasonably large dose of morphine, he should be transported to the operating room, where with the benefit of a good anesthesia, a satisfactory secondary closure may be accomplished. This procedure is in general agreement with most writers (33, 94, 78, 3, 34, 19, 47, 62, 67, 57). He should be cautioned to keep as quiet as possible; the dressings should be carefully removed, and then with care not to touch the bowel all visible surface of the abdomen should be carefully cleansed with green soap and sterile water. Further preparation of the skin is optional. The wound is then draped and the abdominal wall infiltrated with novocaine for 2 or 3 in. about the incision. This is the anesthesia of choice of most surgeons (33, 94, 78, 3, 34, 19, 47, 62, 67, 13, 12, 30, 104, 70), though a few specifically state that they prefer spinal anesthesia (99, 36, 57). Protruded omentum may be ligated and excised. If the intestines have prolapsed onto the surface of the abdomen, they should be washed with saline solution, and gently returned to the abdomen. The secondary closure of the abdominal wall may now be performed. It is our opinion that the type of secondary closure employed has little to do with the ultimate outcome, although immediate resuture is probably preferable when it does not jeopardize the life of the patient. Any difference in the mortality, however, is probably due to the general condition of the patient, the underlying disease, and the primary operation, rather than the type of treatment instituted in the care of the evisceration. In our series of 33 cases, 13 of the wounds were closed with through-and-through sutures of silk-worm gut or wire. Six patients died. Twelve wounds were closed in layers and tension sutures were also inserted. Seven of these patients died. In 8 cases a tampon was inserted, and in 3 of these the margins of the wound were approximated over the tampon with through-and-through sutures; 2 patients died. Five wounds were strapped with adhesive tape over a pack, and 1 of the patients died while the other 4 were later resutured with recovery.

A review of the literature reveals considerable differences of opinion as to the method of secondary closure, some stressing the importance of layer closure; others closing the incision by means of silk worm gut or wire sutures placed close and including all thicknesses of the abdominal wall. Shipley's method of closure (92)

seems to have considerable merit. He places a gauze pack over the intestines, and this is allowed to protrude through the lower margin of the wound, acting as a drain. Closely spaced interrupted sutures of No. 22 silver wire are then introduced through the entire thickness of the abdominal wall, and are secured by threading the end of the wire through a bone button and twisting on a match stick (Fig. 7). The wire lies outside the gauze pack which serves as a protection against erosion of the bowel wall by the wire, and also prevents the coils of the intestines from protruding between the wire sutures. The edges of the wound are then approximated by tightening the wire. In infected cases a narrow strip of gauze may be placed external to the wire. As the wound edges become more healthy and granulations appear, the gauze under the wire becomes loose and is easily removed. The wires are then tightened further, and by the end of ten days all the gauze is usually out, and the wound edges are closely approximated, after which union usually takes place rather promptly by granulation.

The condition of the patient may make it inadvisable to undertake a secondary closure, because of the presence of shock which sometimes accompanies disruption, or because of the presence of a severe wound infection or general sepsis. Under these circumstances, the method of choice is packing a wound with gauze and strapping with adhesive tape. In this opinion we are in agreement with Colp (22), who states the tampon treatment is the simplest, easiest, and least shocking, and can be done with the patient in bed and without an anesthesia. The packing is gradually removed as healing proceeds, which as a rule requires about five weeks. Grace (35) and Eggers (27) agree with Colp (22), as do Eliason and McLaughlin (28), who employ secondary suture only for patients who were not particularly ill when the complication occurred. It must be remembered that the method of tampon and strapping has the drawback of prolonging the period of healing; and the possibility of the development of a fistula from pressure or obstruction must also be borne in mind. Milbert (72) stresses the fact that tampons and strapping may be used for several days until the patient's condition will permit suture, at which time it may be safely carried out. When there is a questionable obstruction, or in the presence of distention, several authors believe it advisable to perform a Witzel's enterostomy (33, 99). Horner (48) considered this inadvisable. In the case in which dilated loops make their reduction into the abdomen difficult, Pool (82) aspirates the bowel content by inserting a needle through the wall of the bowel and applying suction. Horner (48) reports experiencing this difficulty in a case of recurrent evisceration, in which a tear occurred in the urinary bladder and the intestines could not be returned to the abdomen. The dilated loops were covered with a perforated rubber sheet which was sutured to the skin. Epithelization occurred later and the wound healed with a large hernia. Hernia following disruption is generally considered to be a relatively infrequent complication, regardless of the method of closure. In Sokolov's series (97) the mortality for immediate secondary closure was 32 per cent (132 of 411 cases), contrasted with a mortality of 35.49 per

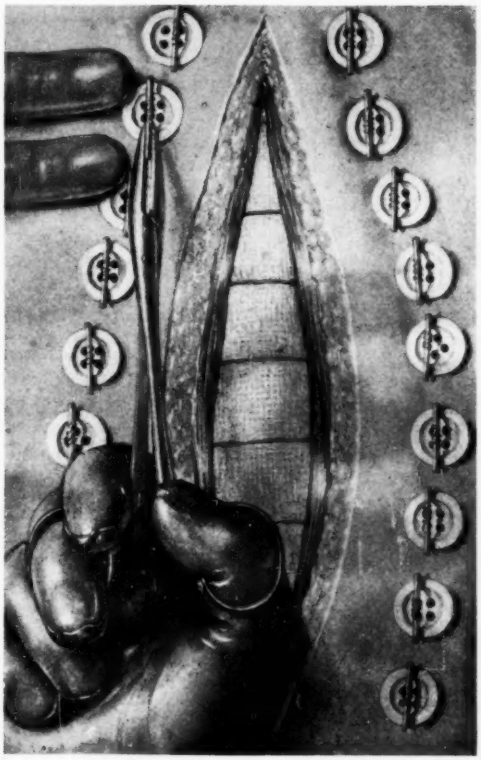

Fig. 7. In Shipley's (90) method of secondary closure of the disrupted wound, closely spaced through-and-through silver wire is inserted and is wound on matches over pearl buttons. A gauze drain of about 8 layers of gauze is placed against the intestines and allowed to protrude through the lower angle of the wound. This protects the intestines, keeps them from protruding, and acts as a drain. (*Ann. Surg.*, 1925, 82: 452.)

cent (72 of 203 cases) in those cases in which the wound was packed and strapped.

As already mentioned, comparative figures regarding the mortality for the method of immediate closure and the method of tampon and strapping are likely to be misleading, because the latter method has been largely used in those patients who are too ill to withstand a secondary suture.

In attempting to evaluate the importance of wound disruption as a factor in the cause of death, it is immediately apparent that this cannot be done with certainty. Many of the patients are desperately ill because of the nature of the original pathological lesion and because of the operation. We are inclined to agree with Milbert (72), who points out that the disruption is often the complication of what would have been a fatal outcome in any event. It seems plausible to consider the disruption at least as a definite contributing factor, but we are unable to determine from our series whether or not the fatalities resulted from the disruption alone. Not many of the major reviews have attempted to evaluate this point. Sigalas (94), however, states that in 30 of 161 cases, disruption was the major cause of death. Glenn and Moore (34) believed that in 10 of 22 patients dying shortly after disruption, the cause of death was due to the disruption. Totten (104) states that in 9 of 19 cases, the disruption was an important factor in the cause of death. A variety of conditions have been listed as the actual cause of death, but many writers consider the fatal outcome to be due to peritonitis.

SUMMARY

From a study of the literature on wound disruption, certain points appear of importance.

The reported incidence of wound disruption averages 1.5 per cent, with a mortality of 35 per cent. The age, sex, and race of the patient are unimportant factors. Seasonal variation may have some bearing, in so far as it predisposes to respiratory infections.

The general condition of the patient and the underlying disease for which the operation is performed must be considered as important predisposing factors. Obesity, anemia, and concurrent systemic disease may affect the progress of wound healing. In addition, there are certain less obvious factors attributable to the patient which influence wound healing. These are Vitamin-C deficiency, hypoproteinemia, and catgut allergy.

Consensus of opinion would indicate that wound disruption is essentially a complication of the vertical incision. We cannot definitely say whether the lower or upper abdominal wound is more prone to disrupt. We believe that any incision which seriously impairs the blood and nerve supply of the abdominal musculature is more prone to separate, and also that it is more difficult to secure and maintain an accurate approximation of the transversalis fascia when its fibers are cut across. We refer mainly to those vertical incisions which split or lie lateral to the rectus muscle. We believe that the preponderance of evidence is against the use of the vertical abdominal incisions, and urge a wider use of the transverse, oblique-muscle, and fascia-splitting incisions whenever possible.

We believe, with the majority of writers, that no method of closure or type of suture is proof against wound disruption. In clean cases, the fine silk closure, as described by Whipple (110), would seem to be ideal. In infected cases, the use of a fine chromic catgut with the "silk technique" is probably as good as any procedure. The value of non-absorbable tension sutures is under considerable discussion at the present time. Those who favor these sutures believe that they take the strain off the suture line, and make for a stronger closure. Those against their use believe that they strangulate tissue, tend to cut through, cause local necrosis, and often result in small stitch abscesses and wound infection.

The through-and-through method of closure with silver or steel wire has many adherents and is undoubtedly an excellent method of closure in infected cases and in those cases in which at the time of closure there is a possibility of disruption. We also believe that there is an additional factor of safety in the application of a good abdominal support.

Drainage through the incision probably favors disruption. It would seem logical to use a stab wound some distance from the incision when possible. If drainage of the incision is considered necessary, the peritoneum should be closed and a drain placed down to it.

With but few exceptions, practically every writer believes that a stormy postoperative course, complicated by coughing, hiccough, vomiting, distention, and undue restlessness, resulting in increased abdominal pressure, predisposes to disruption.

Infection may be considered a contributing factor in wound disruption.

A sharp pain in the vicinity of the incision or a feeling of something "giving way" during a fit of coughing or vomiting may mean a disruption has occurred. A knuckle of bowel may protrude into the deeper layers of the incision and become

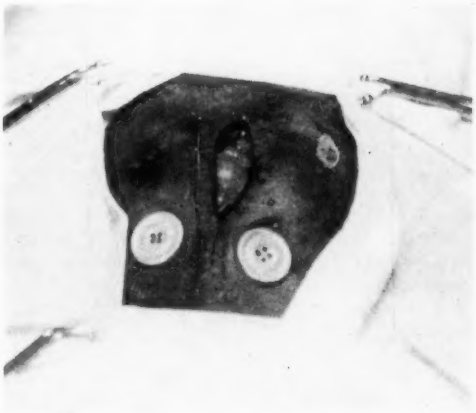

Fig. 8.

Fig. 8. Disruption of an abdominal wound with evisceration, occurring in a sixty-eight-year-old male negro. The patient was thin and undernourished, but seemed to be in fair general condition. He had been suffering from severe intermittent abdominal pain for forty-eight hours prior to admission to the hospital, and a diagnosis of volvulus was made. The abdomen was opened through a mid-left paramedian incision, and a large distended volvulus of the sigmoid was encountered and was easily released. A rectal tube was inserted, and following this marked deflation of the large bowel occurred promptly.

The abdomen was closed with a continuous fine silk suture in the peritoneum and posterior fascia, interrupted silk sutures in the fascia, and 3 fine steel-wire tension sutures including the anterior rectus fascia. The skin was closed with clips. The postoperative course was uneventful. A rectal tube and gastric suction tube were inserted. There was no distention or vomiting. The nasal and rectal tubes were removed on the third postoperative day, and from then on the temperature did not mount above 100 degrees, and the pulse ranged between 70 and 80.

On the seventh postoperative day the wound was inspected. It appeared a little swollen, and it was noticed that the middle tension suture had broken. There was some bloody fluid on the dressing, and following the removal of the skin clips about 2 ft. of small bowel immediately eviscerated. The intestines were reinserted, the wound strapped, and the patient taken to the operating room. Under local novocaine infiltration, a secondary closure was performed using closely placed through-and-through stainless steel-wire sutures.

Inspection of the wound revealed it to be clean, and the margins glistening and free of exudate or granulations, without any evidence of healing. The silk stitches had cut through the tissues.

Immediately following the secondary closure, the serum-protein determination showed 5.6 per cent total. The albumin-globulin ratio was 1.24 (normal total serum-protein determinations average about 7.1 per cent, and the albumin-globulin ratio is normally about 1.53). The ascorbic-acid determination, by the method of Pijoan and Klemperer (79), showed .13 mgm. of ascorbic acid per 100 c.cm. of blood plasma (normals reported by their method range between .65 to 2 mgm. per 100 c.cm. of blood plasma).

The patient was given a transfusion of 500 c.cm. of citrated blood and cevitamic acid. His convalescence following secondary closure was uneventful.

partially obstructed, which results in an increasing degree of vomiting and distention. Often the only sign may be serosanguineous drainage on the dressings.

The most dangerous period is from the fifth to the tenth day.

Following a disruption, it is important that a closure be effected as soon as possible. Immediate resuture is the method of choice in those clean cases in which the patients are not particularly ill. It would seem that some type of non-irritating through-and-through suture, such as steel wire, is preferable. The sutures should be closely spaced, in order to carefully approximate the peritoneum. In infected cases, or in those individuals who are gravely ill, strapping the wound with flamed adhesive tape over a gauze pack is preferable to immediate resuture.

It is impossible to estimate accurately the effect of disruption upon the mortality. Our impression would be that from one-third to one-half of the deaths occurring shortly after a disruption may be directly attributable to disruption. Peritonitis is the actual cause of death in many instances.

Why does the disrupted wound, secondarily closed, often heal so promptly? This is a difficult question, and, so far as we know, has not been positively answered. Recurrences have been reported, but they are rare. The healing of an infected wound which disrupts seems to need but little discussion. As the infection cleans up, the wound heals by granulation. However, the clean wound which separates without apparent cause and heals rapidly on resuture offers a more difficult problem. Possibly the transfusion, so frequently administered following the secondary closure, may be a factor. Possibly the actual trauma which occurs at the time of the separation and the resuture may afford sufficient stimulation to promote healing.

In attempting to outline a prophylactic régime for the prevention of wound disruption, many of the casual and predisposing factors must be given serious consideration. For the sake of brevity, we have listed below those that seem most important to us.

1. Adequate pre-operative preparation when possible, a diet rich in Vitamin C, and blood transfusions if indicated.

2. The wider use of more anatomical incisions, preservation of the nerve and blood supply, and avoidance, when possible, of the vertical incision through the tendinous attachment of the internal oblique and transversalis muscles.

3. Meticulous surgical technique.

4. An accurate approximation of all layers of the incision, especially the peritoneal layer.

5. Avoidance of the use of catgut, and the wider use of silk in clean cases.

6. Avoidance of drainage through the incision.

7. A satisfactory anesthesia, giving good relaxation.

8. The use of duodenal suction and small intestinal intubation to combat vomiting and distention.

9. The general use of an effective abdominal support.

In concluding this review, we wish to emphasize that it is difficult to evaluate the various factors concerned with wound disruption from the study of the literature. The majority of analyses of clinical cases have been made from inadequate data, a fault from which our own review suffers. Too frequently, it has been necessary to study records which lack sufficient information to form satisfactory conclusions. The basic problem is one of wound healing, and it is difficult to evaluate its components, even when a direct attempt is made upon an individual case. If a study of a series of cases of wound disruption is to be of real value, it would seem logical to attempt analysis of each case as it occurs, with special emphasis on the contribution played by each of the many possible factors involved.

We wish to express our thanks to Dr. Charles G. Johnston for his valuable aid and advice.

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SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Balice, G.: Deep Hematomas and Chronic Phlegmons of the Abdominal Wall Causing Difficult Clinical Diagnosis (Ematomi e flemmoni cronici profondi della parete addominale di difficile diagnosi clinica). *Riv. di chir.*, 1938, 4: 589.

Deep hematomas of the abdominal wall are usually divided into spontaneous and induced hematomas. The former occur without demonstrable cause or on the occasion of a minimal traumatism (cough) and appear nearly always in the sheath of the rectus muscle after rupture of the muscle and its vessels; the latter are caused without doubt by a traumatic lesion of the vessels. About 100 cases of spontaneous hematoma have been reported. The disorder begins like an acute abdominal disease, with intense pain, abdominal tension, and vomiting, while a rather soft tumefaction of varying size develops on either side of the median line above the level of the arch of Douglas and within the lateral limits of the rectus muscle. All kinds of acute abdominal disorders have been erroneously diagnosed in these cases.

Balice describes 2 cases of deep hematoma of the abdominal wall due to wounding of the lower epigastric artery in the course of a surgical intervention for inguinal hernia. Very few cases of this kind have been reported. In the first case the patient felt a sudden, rather acute pain in the region of the right iliac fossa eleven days after a Bassini operation; the pain soon disappeared. On the following day there was a tumefaction which was raised only slightly above the cutaneous plane; it was rather round, painless, and of somewhat elastic consistency, had a diameter of about 10 cm., and was deeply seated and non-adherent to the skin. Contraction of the abdominal muscles made it disappear. A neoplasm was at first suspected, but upon puncture 400 c.cm. of bloody fluid were delivered, and the patient was well within a few days. There seems to be little doubt that trauma of a vessel during the operation had caused late hemorrhage through some mechanism difficult to explain.

In the second case the patient was admitted with the diagnosis of malignant abdominal tumor. He had been operated upon for strangulated inguinal hernia one month previously and, immediately after the intervention, had felt slight pain in the right lower quadrant, which had reappeared at intervals of days and lasted only a few minutes each time. The same symptoms were found as in the first case, but the tumefaction, although slightly movable transversally, was absolutely immovable longitudinally. Median subumbilical laparotomy disclosed a hematoma and the patient was soon discharged as cured. In this case also, the hematoma was ascribed to injury of an epigastric vessel.

Deep chronic phlegmon of the abdominal wall is often mistaken for a malignant tumor because usually there is nearly complete absence of fever, the patient's general condition is bad, the course of the disorder is protracted, and the physical signs are deceptive. Generally, the morbid process originates in the lymph nodes which accompany the epigastric vessels in the suprapubic space, or in the deeper lymph nodes of the prevesical space of Retzius; but phlegmon may develop also in the properitoneal connective tissue which, through peritoneal adhesions, may be in contact with infected abdominal viscera. A case in point is that of a man who was admitted with the diagnosis of malignant abdominal tumor of rather rapid course, in whom a suprapubic hard mass extended laterally toward the inguinal arches. The mass was almost painless, non-adherent to the skin, and immovable. The patient had no fever and was in a debilitated condition. These symptoms and a gonorrheal history of twenty years raised the suspicion of chronic phlegmon, which was confirmed by puncture. RICHARD KEMEL, M.D.

GASTRO-INTESTINAL TRACT

Borst, J. G. G.: The Cause of Hyperchloremia and Hyperazotemia in Patients with Recurrent Massive Hemorrhage from Peptic Ulcer. *Acta med. Scand.*, 1938, 97: 68.

The literature of 1934 and 1935 contained reports of an increase in urea in the blood in most of the patients having had gross bleeding into the digestive tract. In some of the cases this azotemia was so marked that it must have had a deleterious effect on the course of the disease. The factors involved in the causation of this hyperazotemia have not been understood. Some investigators believe that the blood liberated in the intestinal tract is the source of the urea formed. Others believe the urea is due to irritation secondary to dehydration or deficiency of chlorides in the body, which interfered with proper functioning of the kidneys. Still others believe that the toxic destruction of the body proteins plays the most important rôle.

Christiansen directed attention to the low chloride content of the urine and advanced the hypothesis that the symptoms of intoxication were due partly to demineralization. Borst and his co-workers in Amsterdam found that most of the bleeding patients with marked azotemia also have a hyperchloremia, and at the same time an extremely low sodium-chloride excretion in the urine. The administration of sodium chloride would elevate the sodium and chloride content of the blood, but it did not lead to an increase in the sodium-chloride excretion in the urine.

During the past few years these investigators have been studying the excretion of sodium and

chloride in a large group of patients, from which study they have been able to conclude that very rarely an increase of sodium and chloride occurs in the blood accompanied by an almost complete absence of these minerals in the urine. Those cases in which it occurred had possibly one condition in common, namely, an insufficient filling of the blood vessels, or at least of the arterial system, since it was present in cases of severe hemorrhage, dehydration, nephrotic edema, postoperative shock, and in some cases of heart failure.

In order to better understand the cause of this hyperazotemia and hyperchloremia, an extensive study was made of all patients suffering from recurrent massive gastric hemorrhages. For several days the urea content of the blood and the excretion of urea plus ammonia were studied; also the formation of urea and ammonia, and the urea clearance were calculated. An attempt was made to find the cause of the sodium-chloride retention by measurement over a definite period of the intake and output of sodium chloride and comparison of the results with the course of the sodium chloride and the HCO_3 content of the blood plasma. For the sake of comparison the fate of the potassium within the body was also studied. The percentage of hemoglobin was repeatedly estimated and, finally, in order to calculate the colloidal osmotic pressure of the serum, frequent estimations were made of its albumin and globulin content.

Three cases in which all of this was done are reported in detail, with the findings graphed in a most interesting and valuable fashion. A study of these patients developed interesting findings. All patients showed a hyperazotemia. The urea clearance always dropped in the period of shock. Following hemorrhage the circulating blood tends to restore its volume from the extracellular fluids, which means blood dilution, and during this time neither sodium nor chlorides are excreted by the kidneys. This retention of sodium chloride is therefore part of the regulating mechanism established for the purpose of restoring the normal filling of the arterial system from the extracellular fluid. Mechanisms of this type probably occur in all situations in which the arterial system is incompletely filled. The hyperazotemia apparently is secondary to an increased urea formation from retained blood within the bowel, and should the patient be insufficiently fed, metabolism of the body proteins takes place since the blood within the bowel serves as a source of nourishment.

On the basis of all this data on patients with massive hemorrhage, Borst recommends the following treatment:

Following massive hemorrhage an effort must be made to restore the quantity of circulating blood by (1) restoration of the loss of erythrocytes and plasma protein through drip transfusion, and (2) administration of fluids until the urea concentration of the urine drops below maximum and the chloride content rises. Salt may be given only when the sodium-chloride content of the blood plasma is not elevated, but carbohydrates should be administered as soon as possible to prevent body-protein destruction through inanition. In the presence of vomiting or gastric retention 5 per cent glucose is administered subcutaneously, otherwise a 10 per cent cane-sugar mixture with a few drops of orange juice should be administered by mouth. This latter therapy is usually well tolerated.

SAMUEL J. FOGELSON, M.D.

HΦyer, A.: The Roentgen Diagnosis of Intestinal Obstruction. *Acta radiol.*, 1938, 19: 409.

The author reviews his findings following a laboratory and physical examination of patients with intestinal obstruction. It is observed that the roentgen diagnosis of obstruction of the small intestine is based on the formation of a fluid level in the distended gut due to the presence of gas and thin intestinal contents. Fluid levels are found normally in the stomach and in the superior portion of the duodenum, and occasionally in the terminal coil of the ileum. In meteorism, the gas content of the large intestine is increased, and the small intestine may be more or less gas-filled. The conditions which most frequently give rise to meteorism are fermentative dyspepsia, renal colic, biliary lithiasis, acute pancreatitis, intra-abdominal tumors, and cardiac failure.

When there is an obstruction in the small intestine, the immediate result will be an accumulation of thin intestinal contents in an oral direction, while the intestine distal to the occlusion is more or less completely emptied. Following this there is an abnormal fermentation of stagnant intestinal contents with the development of gas and the formation of fluid levels, which, according to Kloiber, commences two or three hours after the onset of the attack. The length of the fluid level varies according to the course of the bowel. The surface of the fluid has a concave shape. The higher the obstruction, the fewer the fluid levels; the lower the obstruction, the greater the number and the more lowly situated the fluid levels. The increased fluid content of the prestenotic segments of the intestine produces an increased general density which is more pronounced in the lower portion of the abdomen because of the fact that the fluid-filled intestines are low, while the gas-filled portions rise. When ascites is present also, the density of the lower abdomen is then increased further. The coil of the intestine lying immediately proximal to the obstruction, the so-called prestenotic coil, rises in the abdomen in the form of a reversed U. A roentgenological symptom which the author believes to be of the greatest importance in diagnosis is the more or less complete absence of gas in the large intestine in the case of obstruction in the small intestine. A roentgenogram which demonstrates fluid in dilated coils of the small bowel is considered by most authors to be pathognomonic of obstruction.

Obstruction of the large intestine is distinguished by distention and the formation of a fluid level in

the part of the large intestine proximal to the obstruction. If the obstruction is complete, the distention may become enormous. At the beginning of obstruction of the large intestine there are no demonstrable roentgenological changes in the small intestine. Not until a large bowel obstruction has been present for a considerable time does the x-ray evidence of ileus spread to the small intestine as well. This is also the case if there is a simultaneous peritonitis.

The earliest diagnosis of intestinal obstruction, in the cases studied by the author, was made nine hours after the onset of the attack. Although the roentgenological changes were vague they were sufficiently distinct to permit the diagnosis of small-bowel obstruction.

From January 1, 1933, to April 16, 1938, the author studied the cases of 26 patients with intestinal obstruction, 21 of whom were examined roentgenologically. Twenty-three patients were operated upon, 3 were discharged as cured without operation, and 3 died. The total mortality was 11.5 per cent, the mortality in the operative cases being 13 per cent. In a period of eleven and one-half years, from 1924 to 1936, 116 patients with intestinal obstruction were treated in the same hospital. The total mortality in this group was 39 per cent, the mortality in the operative cases being 38 per cent. Although it is difficult to compare series which vary so greatly in number, it is evident that the mortality from intestinal obstruction at Aker Municipal Hospital decreased remarkably subsequent to the routine adoption of roentgen examination in cases of suspected intestinal obstruction.

The technique of examination as used by the author is simple. The patient is placed in the erect position, as for a gastric examination; if he is too ill to assume the erect position, a lateral recumbent exposure is made, preferably in the right lateral position. A Lysholm grid is used, care being taken that the stripes are placed vertically, since horizontal stripes on the roentgenograms may form false fluid levels. As a rule the survey film taken in the erect position has been sufficient, but in a number of cases supplementary exposures have been made in the lateral and oblique erect position, as well as in the supine position. In 2 cases a barium enema was also given. In no case was barium given by mouth. The author reports a number of cases, with reproductions of the films. HAROLD C. OCHSNER, M.D.

Bottin, J.: The Treatment of Intestinal Obstruction. *Arch. Surg.*, 1938, 37: 735.

It has been stated that since the beginning of the century, the mortality from intestinal obstruction has remained at about 40 per cent. The knowledge acquired in this field as a result of animal experimentation has not been applied sufficiently to therapy. The author wishes to emphasize particularly that obstruction is rarely a disease *per se*. It is the result of a pre-existing condition or a malformation, or the cause may remain obscure. In all cases the obstruction aggravates the original condition. One must forget the immediate or remote cause of the obstruction and utilize all efforts to relieve the obstruction at the earliest possible time.

The influence of the French and German contributions resulted in the concept that intestinal obstruction produces intoxications of various kinds. Since 1912, the American school, represented by Hartwell and Hoguet and later by Haden and Orr, has changed this point of view, for these men regard death following intestinal obstruction as being due primarily to anhydremia and hypochloremia. A tendency to ignore the toxic factor of the problem has developed. The author believes that intestinal obstruction produces an intoxication, first of the blood and then of the tissues. In addition to this toxemia, there develops dehydration and demineralization of the blood and tissues. These factors alone may account largely for the particular toxemia, to the exclusion of the obstructed intestine. Dehydration and demineralization result in a reduction of the blood volume and blood pressure, in consequence of which there are changes in the tissue circulation of a type which permit the cellular metabolites (some of which are highly toxic) to be imperfectly removed from the blood stream. There is a diminished excretion of urine and tissue intoxication occurs. The gravity of the height of the obstruction is not to be ignored.

Certain principles in the treatment of intestinal obstruction are fundamental. If the patient's condition is not too grave, it may be advisable to postpone operation for several hours in order to restore water and minerals that have been lost. This treatment consists in furnishing the body with water in large quantities, and with simple ions, particularly chlorine, sodium, potassium, and calcium, in an isotonic or mildly hypertonic solution. Local or regional anesthesia are best, but spinal anesthesia may be indicated in certain cases.

An essential of the surgical treatment of intestinal obstruction is always to practice the simplest kind of procedure. It is the obstruction that must always be treated. It alone constitutes the emergency. The aim of all treatment is to remove the obstruction by the simplest means. Experience teaches that frequently a simple operation will save a life and will permit later and safer treatment of the causative lesion. A complicated operation may relieve the obstruction, but will result in a large number of fatalities. If one attempts resection and suture of the obstructed bowel, one must expect some disagreeable complications to ensue. No tissue is less suitable for suture than the obstructed bowel.

The postoperative treatment is most important. Rehydration and remineralization must be accomplished by means of fusions or injections of large amounts of isotonic, or mildly hypertonic, solutions of chloride, sodium, potassium, and calcium. Gastric lavage or, better, duodenal suction by the Wangensteen method is excellent for removing the toxic material from the stomach and small bowel.

The author reports 55 fatalities among 302 patients who were operated upon for mechanical obstruction of the bowel, a percentage mortality of 18.25, which is relatively small. The cause of death in the majority of instances was not the obstruction. All but 4 or 5 patients in this series were relieved of their obstruction during the course of the operation. The safety of the patient lies in the less complicated and most simple procedures. The surgeon's first concern must be to save the patient's life.

Postoperative ileus is a peculiar and particular form of ileus, either paralytic or spastic, which may follow any operative intervention, but most frequently follows an abdominal operation. Postoperative obstruction dependent upon a more or less severe peritoneal infection belongs in the domain of the functional type of obstruction consecutive to peritonitis. The author refers here to postoperative ileus without any sign of peritoneal reaction. The cause of paralytic ileus remains unknown. For its treatment, the writer uses gastric lavage, duodenal suction, hot applications to the abdomen, and hot and cold enemas. At best, the results are most uncertain. One may employ certain pharmaceutic products, such as posterior pituitary extract, peristaltin, acetylcholine, and physostigmine. In some of the author's cases, treatment was followed by the passage of gas and feces, while in the majority of cases the drug proved inefficacious. Morphine has been advocated in recent years to re-establish intestinal peristalsis. This therapy has not given the results expected of it in the author's hands. Leriche advocates the use of spinal anesthesia in paralytic ileus, and the method has been rapidly popularized. Some patients have a prompt evacuation shortly after the injection, but such a result is not always to be expected. It is essential to use caution, since the method may result in regrettable accidents.

In conclusion the author states that some of the methods used for the treatment of postoperative ileus are not applicable if the intestinal paralysis is due to an inflammatory peritoneal exudate which should not be spread by increased peristalsis. It may be wise to splint the bowel with morphine in order to localize the infection. The author considers the most effective therapy against postoperative ileus to be the replacement of large quantities of fluids and minerals. Blood transfusion also is valuable at times. Of all the therapeutic measures in the treatment of intestinal obstruction, rehydration and remineralization give the most satisfactory results. In certain cases, all methods of treatment employed have failed to save the patient. In such instances the performance of simple enterostomy may have a place.

JOHN W. NUZUM, M.D.

Niosi Cusimano, G.: Intestinal Occlusion and Appendicitis (Occlusione intestinale e appendicite). *Minerva med.*, 1938, 29: 593.

Niosi Cusimano reports 8 cases of mechanical intestinal occlusion due to appendicitis. These occlusions may occur during the evolution of an appendicitis which is or is not complicated by a localized or diffuse peritonitis (5 cases), after an appendectomy (early or late postoperative occlusion, 3 cases), or some time after an appendicitis that has been medically cured or become chronic. In the first group, 4 cases were complicated by peritonitis; in the second group, 1 case occurred three months after the appendectomy and the 2 other cases were represented by 1 patient who again had an obstruction after an interval of ten years.

In cases in which the occlusion occurs after the operation, drainage has been inculpated as the primary cause of the accident. Undoubtedly, the influence of drainage has been grossly exaggerated and the occlusions should be attributed largely to peritonitis with its consequences. The frequency of occlusion due to appendicitis in the author's material has been 0.88 per cent, although other statistics give higher figures. The symptoms and diagnosis of these occlusions do not differ from those of occlusions from other causes, and an attentive observer usually discovers the mechanical obstacle when it is present. In addition, mechanical occlusion runs a progressive tumultuous course which rapidly alters the general condition of the patient; paralytic ileus, on the other hand, remains stationary and often regresses spontaneously.

The ideal treatment consists in the removal of the obstacle through ample laparotomy and the re-establishment of the natural canalization of the intestine. However, in cases of stercoremia, the immediate intervention is limited to enterostomy cephalad to and not far from the obstacle, and the radical operation is deferred until the general condition of the patient is more favorable. In cases of postoperative occlusion, a median sub-umbilical incision allows excellent exploration for removal of the obstacle; when there is danger of the re-formation of adhesions or when removal of the adhesions is considered questionable, entero-entero-anastomosis (usually an ileotransverso-anastomosis) is indicated. In cases of pre-operative occlusion diagnosed early, the same incision serves the purpose, but the intervention is complicated by the necessity of attending also to the appendix and to a possible abscess. Exceptionally, it may be necessary to excise a portion of the intestine. The second stage of the radical treatment in postoperative occlusions is identical to that of the first stage of radical treatment, but there is no fixed rule in the case of pre-operative occlusions, and the surgeon must be guided by circumstances.

The medical measures to be taken in any case of occlusion include pre-operative lavage of the stomach, the pre-operative and postoperative hypodermic and rectal administration of physiological salt solution, the intravenous injection of hypertonic salt solution (from 15 to 20 gm. of salt every twenty-four hours), and cardiac stimulation.

Of the 8 patients, 5 were cured and 3 died; 2 deaths are attributed to the abscess that complicated the appendicitis, and 1 death occurred in a woman, aged

seventy-three years, who developed peritonitis. The prophylaxis of occlusion consists of early operation of the appendicitis, within the first twenty-four to thirty-six hours, perhaps even within the first forty-eight hours. The diagnosis of acute appendicitis is rarely difficult and errors may be avoided by a complete clinical and laboratory examination. Diagnostic errors are especially likely to be made in the case of children, in whom pneumonia or diaphragmatic pleurisy may cause pain in the region of the appendix or pneumococcic peritonitis may raise the suspicion of appendicitis complicated by peritonitis.

RICHARD KEMEL, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Cole, W. H., and Rossiter, L. J.: The Relationship of Lesions of the Cystic Duct to Gall-Bladder Disease. *Am. J. Digest. Dis.*, 1938, 5: 576.

In a series of cases of gall-bladder disease, the authors noted that not infrequently the fundus of the gall bladder which had been removed showed very little, if any, evidence of disease, but the pathological changes observed in the cystic duct were sufficient to explain the gall-bladder symptoms. Most of these lesions in the cystic duct were of the type capable of producing obstruction of the duct, especially if a local temporary disease produced edema at that point. Many such lesions cannot be identified until after cholecystectomy, when the cystic duct can be opened. If the symptoms are caused by lesions of the cystic duct, cholecystectomy will relieve the patient; however, in at least one type of biliary dyscinesia such a procedure is not likely to alleviate the symptoms.

The cystic duct is subject to many variations and anomalies, as are the valves of Heister. Normal valves of Heister do not offer significant obstruction to the flow of bile into, or out of, the gall bladder. Inflammatory or congenital lesions of these valves may offer a certain amount of resistance to the flow of bile through the cystic duct, particularly if such impingement is increased by an acute inflammatory reaction in this area. Obviously, prolonged obstruction of the duct from any cause will produce hydrops or empyema of the gall bladder. The authors point to the frequency of congenital lesions of the cystic duct that do not produce symptoms until late adult life when inflammatory processes are most likely to be superimposed. Repeated inflammatory processes may lead to scarring with permanent partial obstruction of the duct.

Partial obstruction of the cystic duct of a gall bladder, the wall of which is sufficiently normal to concentrate bile, will be more apparent, as the thin fluid bile may pass freely into the gall bladder, but the more viscid, concentrated bile will pass less readily from the gall bladder through the partially obstructed cystic duct. In the authors' series of patients, the pain was most severe in those with gall bladders which filled and concentrated the bile, but in which emptying was delayed, as demonstrated by cholecystograms. Therefore they attach a new possible significance to a delayed emptying time of the gall bladder following a fatty meal, as observed during cholecystography.

The authors discuss obstructive lesions of the cystic duct under eight main heads: (1) stenosis due to extrinsic adhesions, (2) stenosis due to a thickened wall, (3) congenital or inflammatory twists or kinks, (4) congenital or inflammatory lesions involving the valves of Heister, (5) stone in the duct, (6) tension induced by an enlarged liver, (7) compression due to tumor or lymph nodes, and (8) obstruction due to an anomalous hepatic or cystic artery.

The authors report the cases of 7 patients operated upon for gall-bladder disease, in whom the major portion of the significant lesion was in the cystic duct. In 3 patients, normal filling and concentration was observed in the cholecystogram, but a delayed emptying-time followed the fatty meal. In 4 patients, no shadow was observed during cholecystography. All 7 patients are free of their symptoms, but all operations have been so recent that the permanency of the cure cannot be determined.

EARL O. LATIMER, M.D.

Canónico, A. N.: Experimental Obstruction of the Common Duct and Decompression of the Obstructed Biliary System (Obstrucción coledociana experimental y descompresión del sistema biliar obstruído). *Bol. inst. de. clin. quir.*, Univ. de Buenos Aires, 1938, 14: 1309.

Clinical observations on patients with obstructive jaundice frequently disclose differences between various organic reactions before and during the surgical drainage of bile. These circumstances induced the author to study experimentally the effects of decompression of the biliary system. A total or partial obstruction of the common duct was produced in dogs by means of Goldblatt's clamp or rubber bands, and either a rapid or a slow decompression was instituted. In addition to the quantitative and qualitative determinations of bilirubin in the blood and urine, various organs, such as the liver, kidneys, pancreas, intestines, spleen, muscles, heart, eyeballs, and skin, were studied histologically. Particular attention was paid also to the glycogen content of the liver.

A decompression of the biliary system after a previous obstruction of the common duct creates in the dog's liver a marked disorganization of the histological structure. A congestion of the blood capillaries may produce hemorrhages while epithelial cells become detached from the trabeculæ and undergo a necrosis. The longer the duration of the obstructive period, the more pronounced the alteration.

A slow decompression of the partially or completely obstructed biliary system does not produce such pronounced disturbances. The afore-mentioned intrahepatic changes are attributable to the rapid fall of the biliary pressure and a concurrent increase

of the blood pressure. The glycogen content of the liver is closely related to the biological changes in the liver cells provoked by the rapid or slow decompression of the biliary system.

A rapid decompression produces degenerative changes also in the kidneys. The author's experiments furnish an anatomicophysiopathological proof of the existence of the hepatorenal syndrome following a decompression of the obstructed biliary tree. An obstruction of the common duct causes first changes in the liver, then alterations of other important parenchymatous organs. A biliary obstruction of a non-infectious origin thus creates a decidedly toxic-degenerative condition with a progressive evolution. Not only the liver, but also the central nervous system, myocardium, and suprarenal glands may suffer. Not a rapid but a gradual decompression of the biliary system should be employed in order to minimize the undesirable effect on the liver. For this purpose the technique described by Ravdin and Frazier may be employed. JOSEPH K. NARAT, M.D.

Poetz, P.: The Importance of the Lymph Glands About the Common Duct as a Cause of Biliary Stasis (Die Bedeutung der Lymphdruesen am Ductus choledochus als Ursache der Gallenstauung). Giessen: Dissertation, 1938.

Pathologically altered lymph nodes may cause biliary stasis by compression of the common duct, but the author found only 30 cases of this kind in the literature. Examination of the records of 7,000 operations on the biliary tract performed in the Surgical Department of the University of Giessen revealed 58 cases of enlarged glands surrounding the common duct. The anatomy of the lymphatic system of this region is discussed. Four cases taken from the literature are cited in which jaundice was caused by swelling of the lymph glands and compression of the common duct. Tuberculosis or simple hyperplasia may cause glandular enlargement.

In many cases the cause is not clear. In this article 15 cases belonging to this group are discussed. In the literature tuberculosis is regarded as the etiological factor in one-third of the cases, but the author found only 4 cases in his series of 58 in which this was true. Other causes were grippe (1 case), probably delivery (4 cases), ulcer of the stomach or duodenum (7 cases), and carcinoma with lymph-node metastasis (9 cases). Non-specific lymphadenitis was found most frequently, which is in accordance with data found in the literature. In 72 per cent of the cases the author found an associated cholelithiasis. In 50 per cent of the cases changes were found in the pancreas (induration and enlargement of the head), but it is possible that in these cases a lymphangitis pancreatica (Arnsperger) rather than a real pancreatitis existed. Jaundice was caused by the glandular enlargement in 78 per cent of the cases. The disease picture is variable: intermittent colic and jaundice; a persistent sensation of pressure in the right upper quadrant usually resembling the symptoms of cholelithiasis. In some cases the picture was more that of a tumor occluding the common duct with increasing jaundice and pruritus but without pain (1 case). There are also cases which in the beginning present gastric pain and later develop colic, with or without jaundice. In none of the cases could the exact diagnosis be established before operation, either by clinical or chemical means. Cholelithiasis or neoplasm of the biliary tract was the pre-operative diagnosis in all cases. From a differential diagnostic viewpoint it is important to note that the patients are usually in a younger age group, between twenty and forty years of age, and most frequently between twenty and thirty years of age. The author found that 82.7 per cent were females and 17.3 per cent were males. When the glandular enlargement is not too extensive and stones are present at the same time the diagnosis at operation may be difficult.

The ideal treatment is radical removal of the involved lymph nodes. If this is impossible, the bile should be drained into the intestine by the various procedures. Jean advocates the removal of the gall bladder in all cases, particularly when it is diseased primarily and if it is the cause of the glandular enlargement. Roeden advises the removal of the gall bladder only in those cases in which it shows marked inflammatory changes. The type of operation, therefore, must be determined according to the findings. If malignant involvement has caused glandular swelling a short circuiting operation should always be performed. In the author's cases the gall bladder had been removed in 67 per cent, but removal was not always absolutely indicated. The mortality was 6.9 per cent, due mainly to circulatory failure. During operation upon jaundiced patients it is important to determine the presence or absence of enlarged nodes, which in some cases may be the sole cause of the jaundice.

(RINTELEN). JOHN A. GIUS, M.D.

MISCELLANEOUS

Wakeley, C. P. G.: Obturator Hernia: Its Etiology, Incidence, and Treatment, with 2 Personal Operative Cases. *Brit. J. Surg.*, 1939, 26: 515.

More than 400 cases of obturator hernia have been reported. The author adds 2 detailed case reports with a description of several museum specimens. The anatomy of the obturator region is discussed and illustrated. This condition is most commonly found in elderly females, although it has been recorded in patients as young as twelve years of age. Anything that increases abdominal pressure, such as pregnancy, chronic prostatitis, and chronic constipation, may be the cause of it.

The signs and symptoms of obturator hernia are not constant. The most common symptom is the result of pressure on the obturator nerve. This is due to the fact that the obturator nerve is infringed upon by the hernial sac (Fig. 1). When the pain is referred to the knee in an elderly female it is often mistaken for chronic arthritis. Vaginal examination

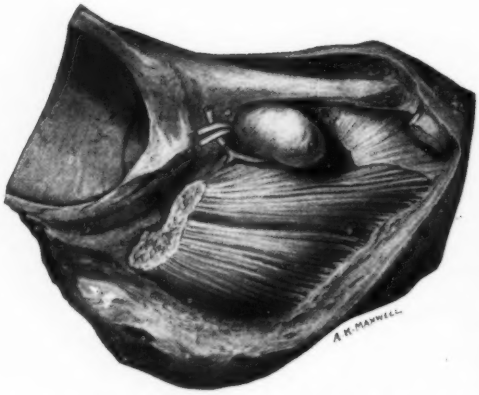


Fig. 1. Obturator hernia (Specimen 6787.1 in R. C. S. Museum).

Fig. 2. Drawing showing the relations of an obturator hernia and how a vaginal examination may aid diagnosis.

may show a tender mass in the region of the obturator foramen (Fig. 2). The diagnosis of obturator hernia should be considered in elderly females who complain of vague abdominal pain associated with intermittent pain in the muscles of the thigh.

The abdomen is opened through a low, abdominal paramedian incision with the patient in the Trendelenburg position. If it is necessary to incise the fibrous ring of the sac, care should be taken that division of the obturator vessels and nerves is avoided. The sac is inverted and securely closed.

ROBERT ZOLLINGER, M.D.

GYNECOLOGY

UTERUS

Baer, J. L.: The Cervix Uteri in Obstetrics and Gynecology. *J. Am. M. Ass.*, 1938, III: 2357.

The interlocking pathology and the principles of treatment of the cervix uteri demonstrate well the unity between obstetrics and gynecology. The cervix is not merely an appendage protruding into the vagina. It is a distinct structural and functional entity. Its disorders may be related to its rôle in obstetrics or gynecology, or in both. This concept is vital to intelligent treatment.

The cervix is the conic or cylindrical termination of the uterus, usually 3 cm. long. Of this two-thirds protrudes into the vagina, the portio vaginalis, and one-third is the so-called supravaginal portion.

The structure of the cervix, unlike that of the muscular corpus uteri, contains little muscle but much connective and elastic tissue. It is comparatively firm and unyielding. The superior end, the isthmus, is more muscular, like the corpus, but somewhat softer. This gives it the effect of a double hinge, which permits of ready backward and forward displacement of the corpus in the pelvic cavity. Whoever practices obstetrics must be familiar with the remarkable softening of the zone between the corpus and the portio in early pregnancy, the "Hegar sign." In late pregnancy and labor there appears the striking phenomenon of formation of the "lower uterine segment," that thinned-out zone between the contractile corpus and the dilating cervix. These alterations involve the same segment of the uterus, the isthmus uteri.

The cervical canal extends from the external os to the anatomical internal os, is narrowest at these two points, averaging 4 mm. in diameter, and is slightly spindle-shaped, averaging 7 mm. transversely at its widest point. In the formation of the cervix, the anterior and posterior walls are the stoutest. This becomes striking on examination of the post-partum cervix, and after involution the canal is found to be much wider as a result of the yielding and overstretching of the lateral walls. Histologically, the lining membrane of the cervix is characterized by the presence of mucus-secreting glands which point downward and toward the canal and by the absence of cilia. The mucosa of the isthmus resembles that of the corpus. It can be distinguished by the direction of the glands. Those of the corpus point downward and toward the cavity and those of the isthmus upward and away from the canal.

The most striking histological fact in connection with the cervix deals with the changes at the external os. The forward and backward interplay between the cuboidal cervical mucosa and the squamous epithelium covering the portio, with the external os as the prize, begins in fetal life. At the seventh month the canal of the cervix is lined by squamous epithelium. At birth the endocervix has pushed back the squamous epithelium beyond the external os and onto the portio in approximately 30 per cent of female infants, the so-called congenital pseudo-erosion. Within the first year of life in most of these infants, the squamous epithelium acquires the mastery and the external os becomes the dividing line. Again at puberty a secondary physiological pseudo-erosion may occur, which likewise tends to recede. This struggle continues throughout life.

In adolescence and maturity the epithelium covering the portio is subjected to the hypersecretions of the cervix which accompany certain constitutional diseases and to the irritation of cervical discharges due to inflammation. In either case, the squamous epithelium is macerated, and the red mucus-secreting endocervix advances to erosion, which may be small and superficial, or huge, furrowed, and even papillary. Lastly, the cervix, which has been traumatized in labor, heals with gaping, gradual eversion, ectropion, and erosion.

Postmenopausal atrophy of the corpus and cervix uteri is effected by two distinct influences. Atrophy of the corpus and its endometrium results from disappearance of the ovarian stimulus. Diminished circulation produces gradual atrophy of the cervix but to a much smaller degree than the shrinkage of the corpus. The endocervix retains its mature form and function (vaginal lubrication), since the cervix is not under the direct influence of the ovarian stimulus.

Fertilization, pregnancy, and labor proceed normally only when all the organs involved are normal in structure and function. For fertilization the cervix should point posteriorly at right angles to the vaginal axis. Retroflexion, retroversion, and prolapse may render fertilization difficult or impossible.

The persistence of congenital pseudo-erosion or the development of pseudo-erosion after puberty, the erosion produced by inflammatory destruction of the epithelium covering the portio, and its replacement by the endocervical epithelium, cervical laceration in labor with resultant eversion and erosion formation, all act as more or less insurmountable barriers to fertilization.

Endocervicitis not infrequently converts the normal alkaline cervical secretion to an acid secretion repellant to the spermatozoa. An endocervicitis may be the starting point of a puerperal infection with its chain of sequelæ.

When pregnancy has been established, the cervix becomes increasingly important. It is the living barrier and barricade. It locks the developing fetus and its protective fluid chamber within the corpus cavity. It absorbs the shock of impact which may accompany coitus. It accumulates the mucus

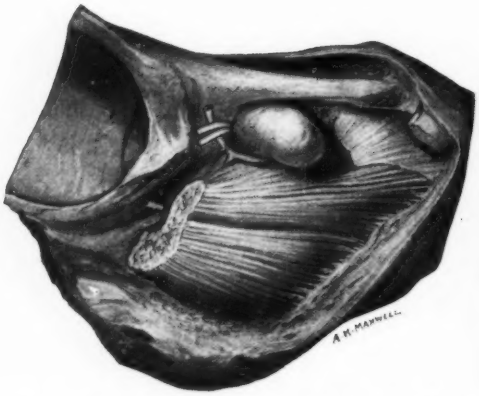
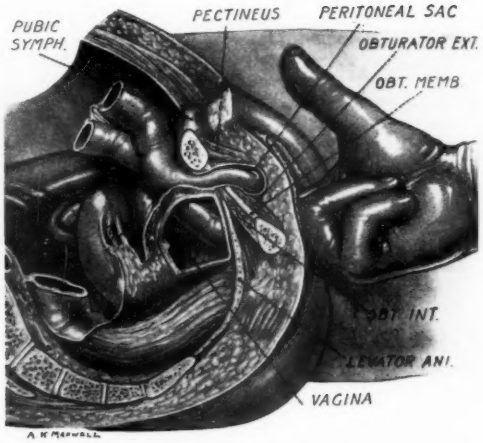


Fig. 1. Obturator hernia (Specimen 6787.1 in R. C. S. Museum).



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ROBERT ZOLLINGER, M.D.

GYNECOLOGY

UTERUS

Baer, J. L.: The Cervix Uteri in Obstetrics and Gynecology. *J. Am. M. Ass.*, 1938, 111: 2357.

The interlocking pathology and the principles of treatment of the cervix uteri demonstrate well the unity between obstetrics and gynecology. The cervix is not merely an appendage protruding into the vagina. It is a distinct structural and functional entity. Its disorders may be related to its rôle in obstetrics or gynecology, or in both. This concept is vital to intelligent treatment.

The cervix is the conic or cylindrical termination of the uterus, usually 3 cm. long. Of this two-thirds protrudes into the vagina, the portio vaginalis, and one-third is the so-called supravaginal portion.

The structure of the cervix, unlike that of the muscular corpus uteri, contains little muscle but much connective and elastic tissue. It is comparatively firm and unyielding. The superior end, the isthmus, is more muscular, like the corpus, but somewhat softer. This gives it the effect of a double hinge, which permits of ready backward and forward displacement of the corpus in the pelvic cavity. Whoever practices obstetrics must be familiar with the remarkable softening of the zone between the corpus and the portio in early pregnancy, the "Hegar sign." In late pregnancy and labor there appears the striking phenomenon of formation of the "lower uterine segment," that thinned-out zone between the contractile corpus and the dilating cervix. These alterations involve the same segment of the uterus, the isthmus uteri.

The cervical canal extends from the external os to the anatomical internal os, is narrowest at these two points, averaging 4 mm. in diameter, and is slightly spindle-shaped, averaging 7 mm. transversely at its widest point. In the formation of the cervix, the anterior and posterior walls are the stoutest. This becomes striking on examination of the post-partum cervix, and after involution the canal is found to be much wider as a result of the yielding and overstretching of the lateral walls. Histologically, the lining membrane of the cervix is characterized by the presence of mucus-secreting glands which point downward and toward the canal and by the absence of cilia. The mucosa of the isthmus resembles that of the corpus. It can be distinguished by the direction of the glands. Those of the corpus point downward and toward the cavity and those of the isthmus upward and away from the canal.

The most striking histological fact in connection with the cervix deals with the changes at the external os. The forward and backward interplay between the cuboidal cervical mucosa and the squamous epithelium covering the portio, with the external os as the prize, begins in fetal life. At the seventh month the canal of the cervix is lined by squamous epithelium. At birth the endocervix has pushed back the squamous epithelium beyond the external os and onto the portio in approximately 30 per cent of female infants, the so-called congenital pseudo-erosion. Within the first year of life in most of these infants, the squamous epithelium acquires the mastery and the external os becomes the dividing line. Again at puberty a secondary physiological pseudo-erosion may occur, which likewise tends to recede. This struggle continues throughout life.

In adolescence and maturity the epithelium covering the portio is subjected to the hypersecretions of the cervix which accompany certain constitutional diseases and to the irritation of cervical discharges due to inflammation. In either case, the squamous epithelium is macerated, and the red mucus-secreting endocervix advances to erosion, which may be small and superficial, or huge, furrowed, and even papillary. Lastly, the cervix, which has been traumatized in labor, heals with gaping, gradual eversion, ectropion, and erosion.

Postmenopausal atrophy of the corpus and cervix uteri is effected by two distinct influences. Atrophy of the corpus and its endometrium results from disappearance of the ovarian stimulus. Diminished circulation produces gradual atrophy of the cervix but to a much smaller degree than the shrinkage of the corpus. The endocervix retains its mature form and function (vaginal lubrication), since the cervix is not under the direct influence of the ovarian stimulus.

Fertilization, pregnancy, and labor proceed normally only when all the organs involved are normal in structure and function. For fertilization the cervix should point posteriorly at right angles to the vaginal axis. Retroflexion, retroversion, and prolapse may render fertilization difficult or impossible.

The persistence of congenital pseudo-erosion or the development of pseudo-erosion after puberty, the erosion produced by inflammatory destruction of the epithelium covering the portio, and its replacement by the endocervical epithelium, cervical laceration in labor with resultant eversion and erosion formation, all act as more or less insurmountable barriers to fertilization.

Endocervicitis not infrequently converts the normal alkaline cervical secretion to an acid secretion repellant to the spermatozoa. An endocervicitis may be the starting point of a puerperal infection with its chain of sequelæ.

When pregnancy has been established, the cervix becomes increasingly important. It is the living barrier and barricade. It locks the developing fetus and its protective fluid chamber within the corpus cavity. It absorbes the shock of impact which may accompany coitus. It accumulates the mucus

which is no longer carried out with the menstrual flow and so provides an effective plug against bacterial invasion of the corpus cavity. If now the cervix is too short, whether congenitally or because of operative or traumatic destruction, or if previous trauma in labor has left it gaping widely, it is easy to understand how abortion may ensue.

Chronic infection of the cervix in the presence of pregnancy has heretofore received little attention. The fear of producing abortion has kept physicians from attempting any direct attack upon the lesion.

Effacement of the cervix, that is, the shortening of the long axis and its eventual merging into the lower uterine segment, may begin weeks before the onset of labor. Dilatation of the external os usually follows the dilatation of the cervical canal. The external os may persist as a pinhole-sized os (conglutinatio) after the cervix is completely effaced and the lower uterine segment is well thinned out. This condition may simulate complete dilatation on rectal examination and may result in application of the forceps to the head, the blades being forced through the uterine cap with inevitable severe injury.

When the cervix has been lacerated in previous labor the external os is no longer a dimple or slit but is a widely gaping orifice bordered by more or less hypertrophied everted anterior and posterior lips, with scar tissue in the lateral angles. This type of multiparous cervix is responsible for precipitate labor, for extensive additional cervical lacerations if the patient is permitted to bear down before dilatation is complete, and for incarceration of the edematous anterior lip between the head and the symphysis, which, unless released by upward dislodgment, may prevent delivery and result in necrosis or avulsion of the incarcerated cervix. In this connection it is interesting to note that there are 17 recorded instances of spontaneous annular amputation of the cervix in labor.

Inspection of the cervix immediately after delivery reveals a massive organ hanging loosely in the upper part of the vagina. The anterior and posterior segments are heavy, while the lateral zones are markedly thinned out. Lacerations when present are usually in the thin lateral walls of the cervix. The distance from the external os to the top of the vagina at this time is approximately 10 cm. A tear of 2 cm. in the lateral zone will, when involution is completed, be nothing more than a physiological nick at the external os. Moreover, attempted suture of these thin edges is usually only a gesture. The patient in whom labor has progressed spontaneously and normally to complete effacement and dilatation, with subsequent advance of the head to the pelvic floor, rarely sustains a major injury of the cervix. Major injuries should be repaired promptly.

When injury is suspected because of operative procedures and inspection reveals a laceration exceeding 2 cm., repair should be carried out with loosely tied interrupted catgut sutures, the first being placed above the angle of the tear. For cervical bleeding one or more sutures may need to be tied more tightly. Repair of old cervical injuries at the time of subsequent delivery is not advisable. The risk of creating atria of infection is greater than the alleged advantage of sparing the patient a subsequent hospitalization.

Operative correction of cervical pathological conditions varies with the lesion and the desired objective. Certain underlying principles may be enunciated. Simple birth injuries which are symptomless and are not accompanied by inflammatory changes require no treatment. If the patient is to retain her childbearing capacity, birth injuries requiring attention must be repaired in such a manner as to avoid undue foreshortening of the cervix. If this is not an objective, other types of repair are available in which preservation of the proper length of the cervix and endocervix is no longer necessary. If the lesion is essentially the result of inflammatory changes with the development of multiple cysts and florid erosions, the cautery is adequate. For deep laceration with heavy scar formation, excision and approximation are indicated. If there is gross involvement of the endocervix as well as multiple cyst formation on the portio, the Sturmdorf operation (cone-shaped excision with utilization of the portio as a new lining for the canal) is excellent. For simple hypertrophy and elongation, low or high amputation is selected in accordance with the patient's wishes concerning pregnancy.

Benign tumors of the cervix, though infrequent, are usually fibromyomas. The accepted treatment is enucleation. In this connection a word of caution is advisable. Many patients with this type of growth are anemic because of protracted menstrual bleeding, with resultant lowered resistance to infection. The cervix is richly supplied with lymphatic vessels which drain into the broad ligaments. Death from sepsis may follow simple enucleation of such a tumor of the cervix. The patient should be prepared by a preliminary blood transfusion, and the field of operation should receive the most scrupulous pre-operative preparation.

Carcinoma of the cervix holds first rank among all the obstetrical and gynecological causes of death. Hinselmann's colposcope was devised to reveal tiny lesions of the cervix which might be incipient carcinoma and promptly curable. Schiller's iodine test was aimed at the same objective. Each of these devices, to be effective, must be used as a routine, with biopsy of any suspicious areas. When the microscopic picture is clearcut, the lesion is usually one which should have aroused suspicion without either one of these aids. Other specimens, studied because they do not take up iodine, may show what Schiller called the pre-invasive stage of carcinoma. Unfortunately this classification is not generally accepted by pathologists. Baer found the colposcope unnecessary and the iodine test inadequate.

The menace of the cervical stump after subtotal hysterectomy has been a source of some concern and an argument in favor of routine total hysterec-

tomy. The Mayos have regarded it as a potential focus of infection resulting in keratitis, iritis, and arthritis of the small joints. If this were so, although atrophy is the common fate of the stump, the source of infection could readily be eradicated by vigorous use of the cautery.

It has been the aim throughout this brief analysis to convey the picture of a structure which, though a part of the uterus, is as distinct from it in function, pathology, and treatment as the hypophysis is from the brain. The full significance of this picture is best understood when viewed through a binocular, one side labeled obstetrics and the other gynecology.

J. Thornwell Witherspoon, M.D.

Stevenson, C. S.: Tuberculosis of the Cervix. *Am. J. Obst. & Gynec.*, 1938, 36: 1017.

Eighteen cases of tuberculous cervicitis are reported. In one the cervix was the sole tuberculous focus of infection in the genital tract, and the only active one in the patient. Tuberculous cervicitis is chiefly of interest because it clinically resembles cervical carcinoma and announces the presence of genital tuberculosis. The cervix is involved in from 5 to 8 per cent of the cases of tuberculosis of the genital tract, and thus appears to have a relative immunity to this infection. About 90 per cent of the cases of cervical tuberculosis are secondary to upper genital-tract infection. A true primary cervical tuberculosis is extremely rare.

The two chief symptoms are a persistent offensive watery leucorrhea, and bleeding following coitus or douching. Physically the cervix shows symmetrical hypertrophy and superficial friability and the portio may show abnormalities ranging from erosion and eversion to ulceration and papillary granulations.

The treatment should be surgical when possible, and as radical as necessary and as the condition of the patient will allow. The microscopic pathology is described in detail. Large tubercles are found, lying snugly up against lymphatic channels deep in the body of the cervix and Langhans' giant cells and tubercles are found scattered through hyperplastic canal mucosa. The term "primary tuberculous cervicitis" demands that the cervicitis be the only tuberculous lesion in the patient.

Edward L. Cornell, M.D.

Ducuing, J.: Clinical Exploration of Pelvic Adenopathies in Cancer of the Cervix Uteri (L'exploration clinique des adénopathies pelviennes dans le cancer du col de l'utérus). *Bull. Soc. de gynéc. et d'obst.*, 1938, 27: 773.

Recently Clement Simon in his article, "Satellite Pelvic Adenopathy," made the statement that "venereologists and surgeons rarely explore the lateral walls of the pelvis." The present writer believes that such a misconception may be attributable to the neglect of surgeons to write about a procedure which they take for granted. Clinical exploration may not suffice to demonstrate involvement of the pelvic glands and a surgical exploration

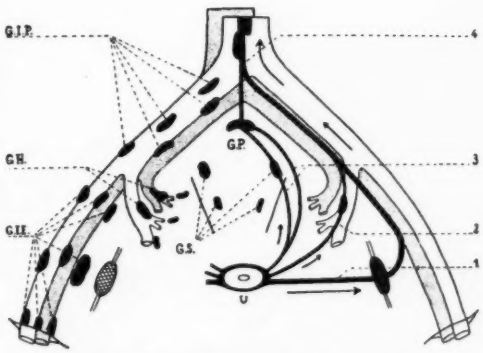

Fig. 1. The glands and lymphatics of the uterine cervix (very schematic presentation).

G.I.E., External iliac glands; G.H., hypogastric glands; G.I.P. primitive iliac glands. These glands constitute three chains very clearly demonstrable at the level of the external iliac vessels: the internal chain or subvenous chain, the mesial or venous chain, and the external or extravenous chain. Below the subvenous external iliac chain is depicted the principal gland of Leveuf (crossed lines) and the obturator nerve upon which it lies: G.P., gland of the promontory; G.S. sacral gland. The three lymphatic paths: 1, the principal path ending in the principal gland (Leveuf); 2, the accessory hypogastric path; 3, the accessory path of the promontory and sacral depots; and 4, the collective trunk of the lymphatic vessels and glands confronting the large prevertebral vessels.

may be required, but in response to the above implication, Ducuing undertakes to describe the procedure employed.

After an introductory anatomical orientation with a schematic graphic illustration of the pelvic glands and lymphatics and the topography of the glands in relation to the pelvis, there follows a discussion of the principal types of pelvic adenopathy and their course, including the anterolateral, posterolateral, and posterior, or sacral adenopathies. The course of the adenopathies associated with cancer of the cervix has no special character. The phase of adenitis corresponds to glandular invasion which has not passed beyond the capsule of the gland; during all this stage the adenopathy is movable and the mucosa of the vagina and rectum is immobilized over it. The phase of infection supervenes during varying periods of evolution of the cancer and of glandular involvement: the adenopathy becomes mixed; the glands, up to this point not very large and hard, increase rapidly in size and become painful and soft. Phlegmons incised posterior to or in the vagina of women treated for cancer of the cervix by radium may probably have been adenophlegmons comparable to those of the broad ligament in non-cancerous women.

An exploration of the pelvic glands is most frequently undertaken to determine the stage of the cancer process. According to the Geneva classifica-

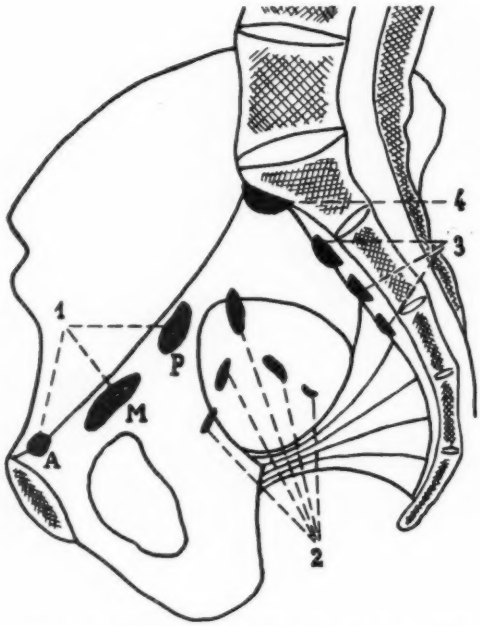

Fig. 2. Location of the pelvic glands in relation to the pelvis (semi-schematic). 1, External iliac glands (subvenous chain): A, anterior subvenous gland; M, mesial subvenous gland (principal gland of Leveuf); P, posterior subvenous gland; 2, hypogastric glands; 3, laterosacral glands; 4, gland of the promontory.

tion, cancers of the cervix with adenopathies belong to the third stage. The present writer urged that this be revised to the effect that cancer of the cervix with adenopathy be classified as belonging to Stage IV, whatever the condition of the cervical lesions. Exploration of the pelvic glands is undertaken also to detect recurrence of cancer and, finally, to determine the cause of pain in this region. The sympathetic paths of sensibility are affected principally by infiltrations of the parametrium; but some paracervical hypogastric adenopathies and more frequently adenopathies of the promontory or presacral adenopathies may cause involvement at the level of the hypogastric or presacral nerves. The cerebrospinal paths of sensibility are more frequently compressed than the sympathetic. This compression may be manifest either at the level of the obturator nerve by "principal" adenopathies, or at the level of the sciatic plexus by hypogastric or sacral adenopathies. In advanced cases invasion of the parametrium and adenopathy become indistinguishable.

The technique of exploration is described in detail, including preparation of the patient by evacuation of the intestine and bladder and placing her in the gynecological position. The different parts of the pelvis must be known as well to the surgeon as they are to the obstetrician, and the position of the glands, as well as they are to anatomists. Both rectal and vaginal routes of exploration should be used. The exploration is made in several consecutive stages, alternately with the right and left hands, special procedures being detailed for examination of the anterolateral zone of the pelvis, the sciatic region, and the sacral promontory.

Difficulties in exploration of the glands are frequently encountered and errors in interpretation are often made in cases of constricted vagina. It is of importance to determine the presence of one or more glands and the nature of the adenopathies, whether neoplastic, inflammatory, or mixed. The usual features of cancerous adenopathy, such as hardness, absence of pain, and adhesion, occur in the pelvic glands as elsewhere. Pain is of importance in establishing the inflammatory nature of an adenopathy, but there are cases of mixed adenopathy which may likewise be painful. Hot water will cause a regression of inflammatory symptoms, and if after regression of a glandular mass, a hard nodule still remains, cancer should be suspected.

EDITH SCHANCHE MOORE.

Martius, H.: Intravaginal Roentgen Irradiation in Carcinoma of the Cervix (Ueber die intravaginale Roentgenbestrahlung beim Gebaermutterhalscarcinom). *Deutsche med. Wchnschr.*, 1938, 2: 953.

This article deals with the advantages of intravaginal roentgen irradiation as compared with the same irradiation method with radium inlays for combating parametrial foci of carcinoma or so-called recurrences in the pelvic wall. The article is illustrated with a number of schematic drawings. An advantage of intravaginal roentgen irradiation is the possibility of easier screening; the screening of radium, the gamma rays of which have a half-value layer of from 9 to 10 mm. of lead, is in practice a very difficult matter even when large quantities of lead are used. It is emphasized that with the first method neither the bladder nor the intestine is exposed, and the primary tumor of the cervix can be included in the irradiation and made to disappear. For this reason Schaefer in Kiel has abandoned irradiation of cervical carcinoma with radium and replaced it entirely with roentgen irradiation. The author does not agree with Schaefer on this point; in the usual case of carcinoma of the portio or cervix he places the radium within the cervix or crater only and no longer in the vagina.

For the irradiation of carcinomatous glands and metastases, both halves of the pelvis are irradiated, in addition, with moderately high fractionated doses. The superiority of fractionated doses as compared with the single total dose consists in the fact that the fractionating and protracting of the dose allows one to take into separate account the radiosensitivity of the different kinds of tissue and thereby heightens electivity in respect to carcinoma tis-

sue. In the experience of the author, the fractionating of the dose and the considerable increase in the total dose which this makes possible have very quickly improved the therapeutic results in recurrences in the pelvic wall. Nevertheless, the supplementary intravaginal roentgen irradiation of Schaefer and Witte presents a new method of attack for carcinoma of the parametrium, in which most of the failures of irradiation treatment must have been observed.

Carcinoma of the body of the uterus also is treated by intravaginal roentgen irradiation as supplementary therapy to intra-uterine radium irradiation. As demonstration of the superiority of intravaginal roentgen irradiation in the treatment of parametrial infiltration foci in comparison with previous methods of irradiation, the case of a forty-nine-year-old woman in whom a carcinoma of the cervix of second grade was irradiated from August to September, 1931, is cited. In December, 1931, carcinoma could no longer be demonstrated; in April, 1932, there was a recurrence in the right parametrium which was treated by protracted percutaneous irradiation; in December, 1932, there was a recurrence, increasing in size, in the right parametrium, which was treated with intravaginal roentgen irradiation with 1,000 roentgens on the right pelvic wall. In April, 1934, the recurrence had disappeared, and upon examination in December, 1937, the patient was free of recurrence.

The author's statistics brought up to December, 1937, show 81 cases of carcinoma of the uterine cervix treated from one and one-half to five and one-half years previously by this method. Twenty-five of the patients are living and free from symptoms, a percentage of healing of 33.5 per cent. On the other hand, the percentage of healing of similar cases treated without the supplementary intravaginal irradiation, and observed over a somewhat shorter time, from one and one-half to four years, was 11.6 per cent. The material contains 37 cases with an observation time of more than three years, and in one-third of these the patients are free from symptoms.

The author feels justified in recommending the further use of intravaginal supplementary irradiation in carcinoma of the cervix.

(F. Siegert). Florence A. Carpenter.

Downes, H. E.: A Statistical Tabulation of the Results of Treatment of Carcinoma of the Uterus. *Med. J. Australia*, 1938, 2: 1030.

The author presents a statistical study of 1,861 cancers of the uterus which were treated prior to June 30, 1934 in the capital cities of Australia, Newcastle, New South Wales, and Launceston, Tasmania. The follow-up system in the 13 hospitals of which the records were used permitted a recording of the end-results in 81.6 per cent of the patients.

There were 7 chorion carcinomas, 221 cancers of the uterine body, and 1,633 cancers of the cervix. Twenty-six per cent of the cancers of the uterine body and 48 per cent of the cancers of the cervix occurred in women under fifty years of age. The percentages of childless patients with carcinoma of the uterine body and with cancer of the cervix were 27 and 10.6 per cent, respectively.

Cancers of the body of the uterus are subdivided into 2 stages: e.g., growths apparently confined to the uterine body were considered to be in the first stage; and growths which had spread beyond the uterus to neighboring organs or to the peritoneal cavity were considered to be in the second stage. The records show that 32.1 per cent of the patients with the less extensive condition, and 8.3 per cent with the more extensive condition, who were treated five or more years ago, were living and free from recurrences. A combination of radiological and surgical treatment proved most efficacious.

The international definition of the 4 stages of cancer of the cervix uteri, as recommended by the Cancer Commission of the Health Committee of the League of Nations, was used in classifying the 1,633 cancers of the cervix in this series. In Stage I, 37.9 per cent, in Stage II, 23.1 per cent, in Stage III, 13 per cent, and in Stage IV, 1.5 per cent of patients who were treated five or more years ago are living without recurrence. Combined radiological and surgical treatment again proved most efficacious.

George H. Gardner, M.D.

ADNEXAL AND PERIUTERINE CONDITIONS

Lenczowski, J.: Primary Carcinoma of the Fallopian Tube (Primaerer Eileiterkrebs). *Ginek. polska*, 1938, 17: 517.

The author describes in detail 3 rare cases of primary cancer of the fallopian tube which were very similar with regard to their clinical course as well as to the anatomical structure of the neoplasm. The patients were forty-nine, forty, and fifty-one years old. Two of them suffered from acute adnexal disease shortly after marriage and remained sterile. The third had 2 premature labors, and both pregnancies were complicated by infection of the urinary tract. After that she did not become pregnant again. It cannot be said with certainty that this last patient did not suffer from early adnexal disease. The leucorrheal discharge in all 3 was not clean; at times it was watery, and in 2 cases bloody secretion occurred between the menstrual periods.

All 3 patients complained of variable pains in the lower abdomen. In 2 cases the pains were of a spastic nature with irritation of the peritoneum and elevation of the temperature. This peritoneal irritation recurred in spite of treatment and, according to the author, is an important symptom in carcinoma of the tube. In 2 cases which were operated upon the disease was bilateral. In 1 of these cases carcinomatous hyperplasia with cystic degeneration was diagnosed in both tubes. A metastatic focus was found in the mucosa of the cavity of the uterus in 1 case, and in the cervix in another. In the third case carcinoma was demonstrated only in the left

tube which was adherent to the posterior cervical surface. The cancer penetrated deeply into the musculature of the uterus. In all 3 cases the tubes were thickened and spindle-shaped and cancerous masses were found in the ampulla and in the isthmus. The histological diagnosis was that of a malignant papilloma. In some areas there were islands of gland-like structure as well as solid masses. In 2 cases adenomyosis of the uterine cornu was demonstrated. The author believes that the cause of cancer of the tubes is inflammation. Two patients died within two years in spite of radical operation and later x-ray treatment. The third patient, who was operated upon lately, is still well.

The author calls special attention to the peritoneal reaction which occurred, but which is seldom observed, and considers it a characteristic symptom of tubal cancer. (B. KOWALSKI). LEO A. JUHNKE, M.D.

Díaz Colodrero, A. A.: Functioning Tumors of the Ovary (Tumores funcionantes del ovario). *Rev. méd.-quirúrg. de patol. femenina*, 1938, 7: 662.

According to Ahumada ovarian tumors may be subdivided as follows: (1) epithelial tumors, (2) fibrous tumors, and (3) teratomas. Epithelial tumors may be benign or malignant and the latter may be subdivided into primary, metastatic, and cystic carcinomas. Some of the primary carcinomas may have a hormonal effect on the genital tract or the secondary sexual characteristics.

Robert Meyer distinguishes the following functioning ovarian tumors: arrhenoblastomas, with a masculinizing effect; granulosa-cell tumors, with a feminizing effect, and dysgerminomas, without an appreciable hormonal function.

The author furnishes detailed histories of 9 cases of dysgerminoma, 10 cases of granulosa-cell tumor, and 1 case of arrhenoblastoma, and discusses the pathogenesis, symptomatology, differential diagnosis, evolution, prognosis, and treatment of the functioning tumors of the ovaries.

JOSEPH K. NARAT, M.D.

MISCELLANEOUS

Hall, F. C.: Menopause Arthralgia. A Study of 71 Women at Artificial Menopause. *New England J. Med.*, 1938, 219: 1015.

Many observers have noted the great frequency with which women at the menopause suffer from arthritis or from vague joint disturbances.

This report includes the study of 71 women whose "arthritis" occurred following castration. Most of them were treated with large doses of estrogenic material over a period of many weeks—some for months and years.

Fifty-three patients suffered from arthralgia rather than true arthritis. Of 40 patients who were adequately treated, 80 per cent were materially (from 50 to 100 per cent) relieved, while 70 per cent responded to the extent of almost complete relief of menopausal and arthralgic symptoms.

There were 18 patients with true arthritis (atrophic, hypertrophic, or mixed). Fifty per cent of those with menopausal symptoms and arthralgia were relieved of these symptoms, and in some cases the arthritis was improved by estrogenic therapy.

There is evidence that the removal of ovarian hormones may cause various joint disturbances, some mild and self-limited, and others severe, disabling, and even crippling, and that estrogenic therapy will prevent or control these disturbances, together with the usual menopausal symptoms, in a high percentage of cases. These arthralgias, therefore, appear to represent one of the symptoms of the menopause.

Evidence has been offered for the existence of a menopause arthritis, better called "menopause arthralgia." It seems proper to reserve this term for conditions associated with deficiency of the ovary and menopausal symptoms. The existence of true menopausal arthritis still remains unproved, but the question merits further study.

CHARLES BARON, M.D.

Geist, S. H., Salmon, U. J., and Gaines, J. A.: The Use of Testosterone Propionate in Functional Bleeding. *Endocrinology*, 1938, 23: 784.

The effect of testosterone propionate was studied in 25 cases of abnormal uterine bleeding. In 21 of these there was no palpable evidence of organic disease; in 4, examination revealed small intramural myomas. Suction curettages were performed before treatment and in 18 cases revealed a secretory phase premenstrually; in 2, hyperplasia of the endometrium; and in 3 others, a proliferative phase during the seventh, sixteenth, and twenty-first day of the cycle, respectively. With doses varying from 300 to 1,000 mgm. per month, the excessive bleeding was controlled in all but 2 cases. In 18 cases normal menses were established; in 5, there has been amenorrhea of from one to five months' duration up to the present time. In 2 cases, the amount of bleeding was not affected. Endometrial biopsies performed during and after the period in which testosterone propionate was administered revealed the following morphological changes: (a) disappearance of the secretory phase (85 per cent); and (b) inhibition of the proliferative phase, often with regression to the hypoplastic or atrophic state. Within a month following the cessation of treatment, the endometrial biopsies revealed evidence indicating a beginning regeneration during the period of amenorrhea. A sufficient number of cases have not yet been followed up for a long enough period after treatment to determine the duration of the therapeutic effect.

Testosterone propionate (in doses of from 300 to 1,000 mgm. per month) inhibits menstruation and arrests the endometrium at the early proliferative phase, which prevents the development of progestational changes. Larger doses cause varying degrees of regression of the endometrium to the state of hypoplasia or atrophy. Following the discontinu-

ance of therapy, the inhibitory effects on the endometrium gradually disappear and normal estrogen and progesterone effects reappear. It is suggested that the regressive changes noted in the endometrium after the administration of testosterone propionate are the end-results of a primary inhibition of the gonadotropic factors of the hypophysis, which causes suppression of the ovarian cycle and consequent cessation of the production of estrogen and progesterone. GEORGE H. GARDNER, M.D.

Figarella, J., and Jean, A.: Primary Evisceration Following Hysterectomy; Clinical, Etiological, and Therapeutic Considerations (L'éviscération primitive après hystérectomie. Considérations cliniques, étiologiques et thérapeutiques). *Gynéc. et obst.*, 1938, 38: 409.

Figarella and Jean report 3 cases of early primary evisceration following hysterectomy, observed in one year, which presented such etiological, clinical, and therapeutic similarities as to allow them to be grouped together.

Postoperative eviscerations are rare and are divided into immediate, early, and late eviscerations; the early ones are the most frequent (80 per cent) and occur about the eighth day after the intervention. Functional and general symptoms are usually discreet and it is only later, when the evisceration has not been recognized or when attempts at reduction by inadequate means have been tried, that the general condition of the patient becomes gradually aggravated. The evisceration is nearly always discovered at the time the last sutures are removed, or even several days later, and its evolution is progressive, the parietal line of suture opening from outside inward until an intestinal loop is exposed. Generally, the aspect of the wound is atonic; no hematoma and no local suppuration are ever observed. The eviscerated organ, which is usually a loop of the small intestine, presents numerous adhesions to the parietal peritoneum.

Etiologically, it is evident that there is a disturbance in the cicatrization of the wound, because of defective functioning of the vascular system at this point. The interfering factors are numerous. Among the pre-operative factors are the general diseases, syphilis being the principal cause of the disturbance in the authors' cases. This was demonstrated by the histories of the patients and the favorable results obtained by specific treatment. The operative factors act only as predisposing causes, while the post-operative factors act partly as predisposing and partly as effective causes; cough, vomiting efforts, early rising, and abdominal distention are found in most histories, but their rôle is purely mechanical. Small parietal suppurations, localized hematomas, and phlebitis of the parietal veins should be more important causes. However, they have not been discovered in the present cases. This leaves only syphilis as the most important factor.

Preventive treatment of evisceration consists of banal precautions: a careful selection of patients should be made, as operation is contra-indicated in obese, aged, and diseased individuals; the Wassermann test is indispensable and, if it is positive, immediate specific treatment must be instituted; strict asepsis during operation, careful suture of the abdominal wall, late removal of the sutures, late rising, and attention to cough, vomiting, and defecation are indicated. When evisceration occurs, medical treatment suffices during the first stage of superficial dehiscence, neoarsphenamine being the most active substance among all the specific drugs. During the second stage, when the intestine is found in the wound, immediate surgical treatment is nearly always necessary; after the liberation of adhesions, the cleansing of the intestinal loops with warm physiological saline solution, and, if necessary, the resection of the margins of the wound, the treatment of choice is closure of the wound in one plane with metallic sutures. Drainage is not indicated except in cases in which the wound is infected or there is a peritoneal reaction. RICHARD KEMEL, M.D.

Loeser, De Larnage, Sabatier, Barbellion, and Others: A Discussion on the Treatment of Genital Gonorrhea in Women (Les traitements de la blennorragie génitale de la femme). *Rev. franç. de gynéc. et d'obst.*, 1938, 33: 687.

In the opening contribution to this discussion, Loeser, of London, describes the treatment of gonorrhea by means of intradermal injections of live cultures of the gonococcus. For the preparation of these cultures a strain, or preferably several strains, of gonococcus from a recent case of gonorrhea is cultured for forty-eight hours on ascitic gelose or ascitic fluid bouillon. If the former medium is used it is diluted with physiological saline for injection; if the latter, dilution is not necessary; 1.5 c.cm. of the fluid is used for injection, a dosage of from 4 to 5 billion organisms. The injection is made into the derma, usually in the forearm. This form of treatment is indicated in acute and chronic gonorrheal arthritis; for women with chronic, resistant gonorrheal infection of the cervix and adnexa; and in more acute cervical infections showing a tendency to extension. The author recommends this treatment also in cases of cervical infection in pregnancy. The injections cause no severe reactions. Among more than 10,000 injections given, of which the author has collected records from his own and other clinics, only 0.06 per cent showed a complication attributable to the treatment, while from 80 to 85 per cent of the cases treated were cured.

De Larnage, of Paris, reports the use of gonococcus vaccine by local application to the cervix, combined with intramuscular injection. The vaccine employed is a filtrate of a pure gonococcus culture, or of a polyvalent culture containing other organisms. Cervical tampons soaked with the vaccine are left in place forty-eight hours; tampons should be placed also in the culs-de-sac; if necessary, intracervical instillations are given, beginning with a small dosage, from 1 to 2 c.cm., and increasing grad-

ually. This method of treatment may be combined with diathermy to relieve pain and if the cervix is ulcerated, with cauterization of the cervix at the end of the vaccine treatment. The author has obtained good results with this method in most cases.

Sabatier, of Montpellier, reports the treatment of gonorrhea in a castrated woman by injections of the follicular hormone, benzoate of dehydrofolliculin. Three injections of 1 mgm. each were given at the beginning of treatment, and after an interval of more than a month, the series was repeated. Not only were the menopausal symptoms relieved, but the gonorrheal lesions (vulvovaginitis) healed promptly with very little local treatment. The author suggests that folliculin is of value not only in gonorrheal vulvovaginitis in children, but also in such lesions in women in the menopause, either physiological or artificial.

Barbellion, of Paris, reports the use of various sulfanilamide compounds in gonorrhea in women, especially 1162 F. He has found this treatment more successful in subacute or chronic cases than in acute cases. In the latter, larger doses are required, and toxic reactions are more likely to occur. In the subacute or chronic cases, a dosage of 2 gm. daily for from eight to ten days usually gives good results if combined with local treatment. The dosage should not exceed 3 gm. daily, and this dosage should not be used for more than five days.

Dalsace and Danziger report the use of the sulfanilamide compound 1399 F in 30 cases of genito-urinary gonorrhea in women. The dosage employed varied from 1.5 to 3 gm. daily for from three to ten days. In 18 cases a cure was obtained, which was confirmed by repeated bacteriological examinations. In 12 cases the patients were not cured, 1 recurrence in two months being included in this group. Twelve of the patients showed slight toxic symptoms, such as cyanosis, headache, vertigo, and insomnia. In 3 cases the treatment did not prevent the development of local or arthritic complications; but in 1 case synovitis of the foot was relieved at the same time that the gonorrhea of the genito-urinary tract was cured.

Durel, of Paris, has found that the chief indications for sulfanilamide treatment in gonorrhea in women are purulent endocervicitis and urethritis. In cases in which there is involvement of Skene's, Bartholin's, or Naboth's glands, supplementary local treatment is necessary to clear up these foci. The two compounds most frequently used are 1162 F and 1399 F; the dosage is the same for both. For most cases, the daily dose is 3 gm. for the first seven days, and 2 gm. for the next seven days. In acute cases and cases complicated by involvement of the adnexa, a heavier dosage is employed, beginning with 4 gm. for the first five to seven days. With this larger dosage patients should be kept in bed and under constant medical supervision. With the usual dosage, a second course of treatment may be given after an interval of at least five days, with doses of from 1.5 to 2 gm. daily for from seven to ten days. With 1162 F, headache and vertigo are the most frequent toxic symptoms; with 1399 F, cyanosis is more frequent. With the dosage employed, these symptoms are usually of mild degree. Iron and alkalis (sodium bicarbonate) may be combined with the sulfanilamide to advantage. The author is convinced that 60 per cent of women with gonorrhea will be definitely benefited by the use of sulfanilamide therapy.

Béclère, of Paris, states that he has used sulfanilamide in the treatment of only 15 cases of gonorrhea in women; 10 of these were completely followed up. Only 1 patient showed definite cyanosis, and 1 developed gingivitis during treatment; when the treatment was discontinued these symptoms subsided. Several patients complained of a feeling of fatigue during treatment. The maximum dosage was 6 tablets a day (3 gm., 1162 F); in several cases, the daily dosage did not exceed 2 gm. During the treatment, patients were kept on a strictly lactovegetarian diet. The most marked effect of the treatment was the prompt diminution and, in some cases, cessation of cervical discharge. For permanent results treatment should be continued for a month. In cases with involvement of the adnexa, diathermy can be combined to good advantage with sulfanilamide treatment; in some cases electrocoagulation of the cervix also is indicated.

Boursat, of Paris, reports the use of sulfanilamide (1162 F) in 50 women (prostitutes) with gonococcus infection. The usual dosage employed was 4 gm. daily for eight days, then 3 gm. for another week. The best results were obtained in endocervicitis; the discharge became clear and was negative for gonococci in about two weeks in 15 cases of this type. The results were less satisfactory in exocervicitis, and in cases with involvement of Bartholin's glands. In cases with involvement of the adnexa, some of which had been treated by other methods without relief, pain was relieved by the sulfanilamide treatment, and this was often accompanied by a diminution in the adnexal mass; in 3 cases this mass entirely disappeared. No serious toxic reactions were observed with the dosage employed; minor symptoms subsided when the medication was discontinued.

Gaté and Cuilleret, of Lyons, have treated 47 cases of gonorrheal urethritis and cervicitis with sulfanilamide (1162 F). At first a dosage of from 3 to 4 gm. daily was given; but more recently the authors have employed an initial dose of 2.50 gm. for five days, followed by from 1.50 to 2 gm. daily for from another thirteen to fifteen days. No other treatment was employed, but in cases in which Skene's or Bartholin's glands are involved, local treatment may be necessary. The authors report a cure, bacteriologically controlled, in all their cases. The treatment was well tolerated; some patients complained of headache, or a transient feeling of weakness; only 1 patient had a skin eruption with fever, and this subsided in three days. Blood counts

showed a slight diminution of both the red and white cells; the cell count returned to normal promptly when treatment was discontinued.

Sosnowska, of Paris, notes that her method of gynecological massage has proved very useful in the treatment of chronic gonorrhea in women, including involvement of the adnexa.

Béclère, of Paris, notes that the involvement of the fallopian tubes in gonorrheal infection in women is often latent, and symptoms may develop only after treatment of the cervical infection has been instituted. In chronic cases in which such involvement of the adnexa is probable, the author advocates diathermy treatment of the adnexa as the first stage in the treatment. The treatments are begun immediately at the close of one menstrual period and continued until the menstruation occurs again. Unless there is a latent hydrosalpinx, this treatment results in relief of pain, diminution of the discharge, and improvement in the patient's general condition. If this is the case the second stage in treatment is electrocoagulation of the cervix. If a hydrosalpinx is present, however, active treatment of the cervix is contraindicated. After electrocoagulation of the cervix, a second series of diathermy treatments is given. The author has used this method for four years with good results.

Halphen, Auclair, and Dreyfus, of Paris, have employed shortwave diathermy in the treatment of gonorrheal infection of the adnexa. Treatment is carried out intensively from the first. Of 200 women treated by this method, 97 per cent were cured within a month and 84 per cent within ten days.

Netter of Paris, in discussing the various methods of treatment proposed for gonorrheal infection in women, notes that the fact that so many different methods have been advocated is an indication that no one method is entirely satisfactory in all cases. Local treatment with antiseptics and tampons is effective only when the infection has not reached the cervix. Vaccine therapy with a specific vaccine is often of value. The new sulfanilamide compounds are undoubtedly effective in many cases of gonorrhea in women. Diathermy, he believes, should be reserved for the more chronic forms of gonorrheal disease of the adnexa. In the treatment of cervical lesions, electrocoagulation of the cervix has very generally replaced cauterization among French gynecologists. Gynecological massage has given good results in cases of chronic gonorrheal salpingitis and cellulitis; it should be employed only when the first treatment causes no reaction within three days.

Chalier, of Lyons, states that he has treated gonorrheal salpingitis as well as other forms of chronic salpingitis by total linear salpingotomy. In this operation, which is not used in cases in which there is pyosalpinx, the tube is liberated from all adhesions, and is then opened up along its entire length; all pathological secretions and inflammatory tissue are removed; any strictures are sectioned. This may be done to best advantage with the electric cutting current. The author has had good results with this operation, and the tubes appear to regain their normal permeability and function. He reports 1 case in which normal pregnancy occurred after this operation. ALICE M. MEYERS.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Concetti, F.: A Contribution to the Histopathological Study of Diverticular Tubal Pregnancy (Contributo allo studio isto-patologico della gravidanza tubarica diverticolare). *Riv. ital. di ginec.*, 1938, 21: 499.

Tubal diverticula may be divided into 3 classes, according to their genesis: (1) total or partial double formations due to congenital malformation; (2) canals issuing from the tube, having a proper tunic, varying in length, and ending in a blind sac, probably also due to malformation (the abnormal development of Mueller's canal); and (3) real diverticula of varying length, generally running in the thickness of the tubal wall. The origin of the last is not well known; in this group may be included the paratubal diverticula often found in nodular isthmic salpingitis.

Concetti describes a case of interstitial pregnancy with a prevailingly intramural location, in which the insertion of the ovum had occurred in a tubal diverticulum. This diverticulum ended in a cul-de-sac in the peripheral part of the external circular layer of the tube itself, and about half way down its course opened into the cavity containing the ovum. The patient was a woman aged twenty-nine years, who died on the day following the intervention for rupture of the ectopic pregnancy. The ovum was found to be in good condition, its histological aspect suggesting that it was still living at the time of operation. The histological examination left no doubt that this was a real diverticulum; its structure, which consisted of cubic epithelium without a proper tunic, and caused the epithelium to adhere directly to the muscular tissue, made it appear to be of inflammatory nature; this supposition was supported by the anamnesis. That the ovum had not developed in the tube but in the diverticulum was proved by the fact that the tube was not enlarged, that its lumen at the point of interruption was of the same size as in other parts, and that the tubal wall appeared to have been worn away from the outside. The external diameter of the ovum with the villi (11.5 mm.) and the approximate diameter of the chorion cavity (8 mm.), the finding of beginning traces of blood vessels without blood in the villi, the size and morphology of the embryonic formations, and the absence of blood spaces in contact with the trophoblast fixed the age of the ovum at about twenty days. The trophoblastic theca, which at some points could be differentiated from the maternal tissue only with difficulty and contained no caryocinetic cells, was least developed on the inside of the most reduced wall, and the decidual reaction was completely absent at this point, although it was present everywhere else in contact with the villi.

The rupture of the ovum cannot be attributed solely to the destructive action of the villi on the wall of the diverticulum; distention due to the expansive power of the ovum must also be taken into consideration. In the present case, the ovum located in a diverticulum exerted a homogeneous concentric compression early. Under the circumstances, the parts of the wall which had good resistance were those that faced the uterus, because they were protected by its backing of muscular tissue, and that directly opposing it, while all the remaining parts were reduced in thickness and more liable to early rupture. This shows that diverticular development of the ovum not only is an important causative factor but it also aggravates the already serious prognosis of extra-uterine pregnancy. A noteworthy observation was that the decidual reaction was found strictly limited to the pregnant territory. This finding seems to indicate that the first determinating stimuli reach the tissues directly from the villi without the intervention of other glands; however, it does not exclude the correlation of a pre-existing gravidic endocrine substrate favoring the decidual reaction.

RICHARD KEMEL, M.D.

Östling, K.: Aneurysms of the Renal, Splenic, and Hepatic Arteries (Ueber Aneurysmen in der A. renalis, lienalis, und hepatica). *Acta obst. et gynec. Scand.*, 1938, 18: 444.

Aneurysms of the renal, splenic, and hepatic arteries are exceedingly rare. In a series of over 10,000 autopsies, 3 aneurysms of the renal and hepatic arteries were found, and 9 of the splenic artery. An account of 3 cases of rupture of such aneurysms in association with pregnancy is given. The rupture of the renal aneurysm occurred shortly before full term; rupture of the splenic aneurysm occurred nine days following delivery; and rupture of the hepatic aneurysm occurred during the eighth month of pregnancy. In all of the cases the symptoms were violent and the patients died within twenty-four hours. The patient with the hepatic artery aneurysm had a definite hypertension of 245/155. None of the cases were diagnosed clinically.

The author's own cases as well as cases published earlier in the literature show that acute cases of ruptured renal aneurysm give symptoms which make a probable diagnosis possible. The patients experience sudden violent pain followed by tenderness and muscular resistance in either renal region. In regard to the other two forms of ruptured aneurysm, it is generally impossible to reach a more definite diagnosis than that of internal hemorrhage. In none of the cases reported by the author was operation carried out. The author believes that operation would prove of no avail in these acute cases. Microscopic study showed all of the patients to have defects of the external elastic lamella, but the genesis of these defects is not elucidated.

AUGUST F. JONAS, JR., M.D.

Valle, G.: The Action of Some Diets on Nephropathies of Pregnancy. Clinical and Experimental Studies (Azione di alcune diete sulle nefropatie gravidiche. Ricerche cliniche e sperimentali). *Ginecologia*, Torino, 1938, 4: 737.

The literature shows that the problem of the participation of diet in the origination and course of renal disturbances during pregnancy is still unsolved. A questionnaire sent to the various obstetrical institutes of Italy to determine the details and results of the dietetic and medicinal treatment in cases of renal insufficiency during pregnancy reveals that dietetic treatment is used in 98 per cent of the cases. Three diets are prescribed: aqueous, lacteal, and lacto-vegetarian, according to the gravity of the cases. It appears that these diets are capable of completely curing about one-third of the cases and of allowing pregnancy to proceed to term in another fifth of the cases, although signs of renal disease persist. Intrauterine death of the fetus occurs in 7 per cent of the nephropathies, and spontaneous premature labor in more than 26 per cent. Forty-five cases of eclampsia, appearing after at least three days following admission, are reported. In cases of hypertension due to renal insufficiency of pregnancy, rest, diet, and purging return the arterial pressure to normal in 80 per cent and reduce it markedly in 15 per cent. The results of medicinal treatment seem to be less uniform.

Valle made a study of a considerable number of healthy and nephropathic pregnant women receiving various special diets, and found that the daily administration of proteins and fats, even in large quantities, did not increase the frequency of clinically demonstrable renal insufficiency in the healthy women, and that generous quantities of proteins, fats, and salt did not cause the appearance of toxic symptoms; however, in some cases the arterial pressure was increased after the ingestion of large amounts of salt. In the cases of renal insufficiency, the saltless meat diet resulted in complete disappearance of the symptoms in slight cases and did not change the albumen rate in the urine in grave cases, but the addition of salt to the diet intensified the symptoms and made them reappear after they had disappeared under the ordinary dietetic treatment; during the puerperium the salt-tolerance test was negative even in cases of grave renal insufficiency. Consequently, an alimentary pathogenesis of the gestoses was excluded; the maternal organism became ill only when the products of the ovum entered the circulation, and salt exerted a toxic action only when the ovular toxins had already caused anatomical and functional changes in the organism. Therefore, it seems dangerous to undernourish the nephropathic pregnant woman, and the following diet is advisable according to the type of cases:

1. In forms of acute renal insufficiency, the diet should correspond to about the standard diet of Karrel (from 800 to 1,000 c.cm. of milk taken in 5 fractional doses), which is preferable to the absolute aqueous diet.

2. If the treatment is not immediately obstetrical, in forms with primary inflammatory character or those aggravated by pregnancy, the diet must cover the basic requirements and be poor in fluids, salt, and proteins.

3. In forms with degenerative character or pregnancy nephroses, which are the most frequent, the diet must provide 2 gm. of protein per kgm. of body weight, from 20 to 40 gm. of fats, and about 300 gm. of carbohydrates per day, a limited amount of fluids, and practically no salt. RICHARD KEMEL, M.D.

LABOR AND ITS COMPLICATIONS

Caldwell, W. E., Moloy, H. C., and D'Esopo, D. A.: Studies on Pelvic Arrests. *Am. J. Obst. & Gynec.*, 1938, 36: 928.

For the purpose of this report, 500 cases have been chosen from selected material and divided into five groups according to the method employed for delivery.

TABLE I.—DISTRIBUTION OF PELVIC TYPES ACCORDING TO THE METHOD OF DELIVERY

	Anthropoid	Anthropoid gynecoid	Android anthropoid	Gynecoid	Android	Android gynecoid	Gynecoid flat	Android flat	True flat	Rachitic flat	Number of cases
Spontaneous	10	15	9	37	10	8	5	4	2	0	100
Low forceps	16	15	10	32	16	5	3	2	1	0	100
Low midforceps	13	10	12	12	21	14	5	9	4	0	100
Midforceps	12	2	12	15	35	9	6	8	1	0	100
Cesarean section	11	5	9	12	41	7	3	6	2	4	100
Total											500

There is an increased frequency of small diameter of the pelvis from the group of cases with spontaneous delivery to the group requiring cesarean section. However, this high frequency of small diameters in low-medium and medium forceps cases shows that small diameters do not preclude the possibility of safe delivery through the natural passages. Safe delivery, under such circumstances, may depend upon the efficiency of the forces of labor or the use of mechanical skill in operative deliveries when the pelvis is abnormal (See Fig. 2, *Internat. Abst. Surg.*, 1939, 68: 501).

Transverse arrest of the head is characteristically associated with either a flat or an android type of pelvis. In delivery, this fact must be appreciated and the transverse position maintained to a low level. If convergence of the side walls exists, then anterior spiral rotation is advisable in android types. Success in manual or forceps rotation at the level of arrest usually implies that an ample anteroposterior diameter is present. In 48 of 100 "medium-forceps" cases, the head was found in the transverse position.

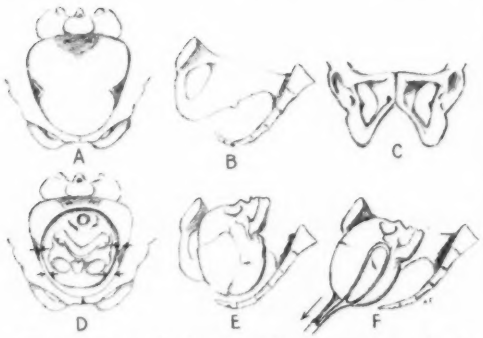

Fig. 1. *The mechanism for delivery from arrest in the occipitoposterior position to lower levels in the same position. A*, Android-anthropoid type of pelvis with a long anteroposterior diameter, prominent ischial spines, and converging side walls. *B*, Lateral view to show ample posterior pelvic capacity because of an average curvature and inclination to the sacrum. *C*, Anteroposterior view of the slightly narrowed subpubic arch. *D*, Arrest in the occipitoposterior position, inlet view. *E*, Arrest in the occipitoposterior position, lateral view. *F*, A pelvic application of pelvic curved forceps is made and traction exerted downward and forward. A low complete rotation may be accomplished with caput in sight.

Arrest of the head in midpelvis in the occipitoposterior position is most frequently associated with two pelvic types: the ample android type with slight convergence, and the flat type with a backward sacrum. These latter two factors (convergence or backward sacrum) create ample anteroposterior space in the midpelvis to allow the occiput to rotate posteriorly. Incomplete flexion and molding of the head favor the maneuver of manual rotation of the head to the transverse position with the application of Barton forceps, followed by lateral flexion and descent with low rotation. Arrest in more characteristic anthropoid forms has been successfully treated by a pelvic application of forceps to the occipitoposterior position with descent to a lower level and rotation with caput in sight. A Scanzoni maneuver was rarely used at the level of arrest and was successful only with a small child in an ample anthropoid form. In the low-medium arrest of the head in the occipitoposterior position the number of characteristic anthropoid forms increases. Maximum flexion and molding of the head have allowed greater success in complete rotation by manual or instrumental methods than occurred with arrest at a higher level.

In a critical review of these cases the authors find that the mechanical procedures employed were open to criticism in at least 10, since the correct methods of obtaining the optimum available space in the pelvis were not used. In 4 of the cases the amount of disproportion present at the time of the forceps operation was a definite contraindication to this procedure, and either a cesarean section should have been done earlier in labor or, if possible, the labor should have been allowed to progress until further molding had occurred.

In the discussion MELHADO said he had encountered abnormal pelves in only 20 per cent of 111 "midforceps" operations, while Caldwell showed 69.3 per cent. This situation is highly contradictory. There must be some explanation for the wide difference in the two clinics, more deeply fundamental than that explainable by methods of classification.

EDWARD L. CORNELL, M.D.

Trillat, P., and Magnin, P.: A Statistical and Critical Study of Retroplacental Hemorrhage Observed in 20,000 Deliveries (Étude statistique et critique des hémorragies rétro-placentaires observées sur un ensemble de 20,000 accouchements). *Rev. franç. de gynéc. et d'obst.*, 1938, 33: 901.

Among 20,000 deliveries at the Maternité Ecole de sages-femmes of Lyons, there were 66 cases of retroplacental hemorrhage. In 14 the placenta was abnormally inserted, but the clinical character of these cases was not essentially different from that of the other cases in which the placenta was normally inserted.

Three clinical types of retroplacental hemorrhage are distinguished:

1. The mild type in which the separation of the placenta is only partial, i.e., involves not more than half the area of the placenta, and a living child is delivered. There were 20 such cases in the authors' series. These cases were delivered normally; in 11 cases the membranes were ruptured artificially and in 1 case digital dilatation of the cervix was subsequently done; in 1 case a digital dilatation after spontaneous rupture of the membranes was performed, and in the remaining cases no obstetrical intervention was used. In only 1 of the cases was there a post-partum hemorrhage of over 1,000 gm.

2. A type of moderate severity in which the infant is dead before delivery, but the mother's condition is not serious; there were 42 cases of this type. In none of these cases was operation performed; of the obstetrical procedures carried out, the most frequent was artificial rupture of the membranes: in 3 cases craniotomy was done; in 2 cases podalic version; in 1 case Braxton Hicks version; in 1, dilatation of the cervix; in 1, bringing down a foot; and in 2 cases forceps were used, but after rupture of the membranes.

3. The severe type of uteroplacental apoplexy; operation was not attempted in any of the 4 cases of this type; 1 of these patients died, the only one in the series. In 2 cases a foot was brought down; in the fatal case this procedure was preceded by rupture of the membranes and a digital dilatation. In 1 case only cervical dilatation was done, and in the fourth case, no obstetrical procedure was used.

In the moderately severe and very severe types of retroplacental hemorrhage (Types 2 and 3) the death of the fetus results from the nature of the placental lesion, and the authors believe that operation is not

of any advantage to the mother. In the least severe type the child is delivered spontaneously if the dilatation of the cervix is adequate; if not, delivery may be hastened by various obstetrical procedures.

In 34 of the 66 cases, including cases of all 3 types, there were no symptoms of toxemia; the mother's condition was better in these cases than in those with an associated toxemia. In this series the majority of the patients were multiparas and more than thirty years of age. In the treatment of these cases, in addition to the obstetrical procedures indicated, physiological saline solution, given subcutaneously or occasionally intravenously, and cardiac tonics were employed. In cases with toxemia, chloral was used, and in 1 case morphine gave favorable results. No oxytocic was used. ALICE M. MEYERS.

NEWBORN

Bessau: Contributions to the Physiology of the Newborn (Zur Physiologic des Neugeborenen). *Arch. f. Gynaek.*, 1938, 166: 419, 479.

Bessau emphasizes those facts in the physiology of the newborn which to him seem most important for the management of the raising of children. He applies the name "stable" functions to those which are already present during fetal life, whereas those functions which characterize extra-uterine life, especially respiration and ingestion of nourishment, are classified under the term "labile" functions. In the presence of subdued excitability of the respiratory center (cyanosis of children) lobelin and icoral are recommended, and attention is called to the importance of the application of warmth in thermolabile children. The metabolic processes represent the chief problems of the physiology of the newborn. Attention is also called to the abrupt change in the manner of nourishment in the transition from intra-uterine to extra-uterine life, as well as to the danger of disturbances which may arise from this transition.

In this discussion Bessau differentiates between dystrophy and dysergia. In part, the effects of this condition are represented by the tendency toward infection, diarrhea, and edema; the first he attributes to the scarcity of antibodies; the second, to insufficient function of the intestinal mucosa; and the third to insufficient capillary function. Attention is also called to the importance of breast nursing and especially to the feeding of colostrum. Bessau is cognizant of the statement previously made by Lindig that the colostrum protein bodies pass directly through the gastric and intestinal walls. Colostrum also has a special significance because of its antibodies and vitamin content; in this connection especial attention is directed to the colon antibodies.

Undernutrition is less harmful than other defects in the administration of nourishment. In an emergency water can be added to the feeding. The mineral content and the vitamin requirements are completely sufficient. In the event that complementary feeding should prove necessary, milk from a wet-nurse is most desirable. However, if this milk is not taken directly from the breast of the wet-nurse it should be carefully protected from colon infection. The sterilized milk of wet-nurses which is obtained at central stations is not equal to the raw wet-nurse milk, but nevertheless it is superior to complementary artificial feedings. According to Bessau, the danger of colon infection stands paramount in every form of complementary feeding. The mortality figure caused by artificial feeding alone, according to Bessau, amounts to 3 per cent.

In concluding, the author calls attention to the technique of weaning by means of which it is possible in institutions to bring about an almost sufficient weaning in 95 per cent of all mothers during the early period of lactation.

(VON JASCHKE). HARRY A. SALZMANN, M.D.

MISCELLANEOUS

Cramer, F. E. K.: The Friedman Reaction in Ovarian Grafts Transplanted into the Anterior Eye Chamber of Rabbits (Reacción de Friedman sobre injertos de ovario en la cámara anterior del ojo de la coneja). *Rev. méd. quirúrg. de patol. femenina*, 1938, 7: 501.

Friedman's reaction allows an early diagnosis of pregnancy. The ovarian graft may be used for repeated examinations. In 1 case the graft remained in good condition for three hundred and thirty-seven days. Careful examination of the graft not only after but also before the injection of the urine is indispensable. Among the complications after the transplantation, opacities of the cornea, prolapse of the iris, and panophthalmia must be mentioned. The author injects intravenously 10 c.cm. of urine the first twenty-four hours and later on 5 c.cm. each day. In many instances only one injection was used. A specimen of the first urine passed in the morning at the temperature of the room is introduced slowly. While several authors recommend an ether extraction of the urine, the writer of this paper does not consider such preparation necessary.

The following changes in the graft may be observed after the injection of the urine from a pregnant woman: (1) congestion, (2) rapid appearance of follicles, (3) increase in the size of the graft, (4) swelling of the iris in the vicinity of the graft, (5) appearance of hemorrhagic follicles, and (6) hemorrhages in the anterior chamber of the eye. On the basis of the congestion alone one is not justified to consider the reaction as positive. The author concludes from his 56 observations that Friedman's reaction is dependable in the diagnosis of pregnancy.

JOSEPH K. NARAT, M.D.

GENITO-URINARY SURGERY

ADRENAL, KIDNEY, AND URETER

Ryle, J. A.: Perinephritis. *Brit. J. Urol.*, 1938, 10: 337.

If those inflammations which follow local injury be excepted, it may be doubted whether perinephritis is occasioned otherwise than by a direct spread of infection from a metastatic subcapsular abscess of the renal cortex. The infecting organism is usually staphylococcus aureus or, more rarely, albus. The renal "carbuncle," to employ the description suggested by Israel in 1890 and revived by Theodore Thompson in 1927, is, in other words, the precursor of a staphylococcal perinephritis in almost every case.

1. In common with bone, muscle (especially the myocardium), skin, the lungs, and the prostate, the kidneys have long been recognized by pathologists as the site of election for metastatic abscesses in fatal cases of staphylococcal septicemia.

2. Perinephritis is a not infrequent association of such a septicemia, and may also complicate a bacteriemia, lacking the clinical manifestations and gravity of a septicemia, and is often transitory.

3. There is a history of recent carbuncle or furunculosis, or other cutaneous sepsis, in upward of 75 per cent of cases of perinephritis. In such cases the renal infection must have been blood-borne. The cellular tissues involved are not accepted as a site of election. Surgical exploration shows that the inflammation starts deep in the muscular planes of the trunk and only approaches the surface at a late stage. Although staphylococcal abscesses occur in muscle, the frequency of localization in the renal angles would be difficult to explain, and muscle abscesses are not, in fact, encountered in the course of explorations for a perinephric abscess.

4. The abscess or carbuncle, sometimes with a discharging crater, can be felt with the exploring finger tip in the upper pole of the kidney in a considerable proportion of cases.

In this connection Lilienthal remarked on the not well recognized absence of urinary manifestations in the majority of these cases.

Although attempts were made to support the conception of lymphatic spread of infection, the consensus of opinion in the last twenty-five years has continued to favor the hemic route. Thompson described renal carbuncle as a rare disease. It is probably much less rare than has been supposed. The author reported additional cases of perinephritis and suggested that the renal cortex is the favorite site for metastatic localization in a staphylococcal bacteriemia occurring in adult life. The condition was rarely found in childhood. There was a high preponderance in males. This has been commented upon by others. If osteomyelitis be accepted as the common serious sequel of a staphylococcal bacteriemia in childhood, renal carbuncle with perinephritis is the common serious sequel in adolescence and middle life.

The interval between the primary infection and the renal metastasis varies from two weeks to two months, its average duration being four weeks. A careful inquiry and search for signs of superficial sepsis should be made in every suspected case of perinephritis.

The first localizing symptom in perinephritis is a deep-seated pain in the loin or flank or iliac fossa (depending probably on the situation of the renal boil or carbuncle), with aggravation by deep-breathing, coughing, or by twisting movements, as on turning over in bed, a maneuver which is always worth observing. One of the author's patients had a renal carbuncle and perinephritis on both sides, with an interval of four years between the two conditions.

In a perinephritis on the left side there may be inhibition of the diaphragm with massive collapse of the left lower lobe, or there may be shoulder-tip pain, or a left basal pleurisy, with or without effusion. There is evidence that a renal carbuncle with only slight symptoms of perinephritis may undergo spontaneous healing without recourse to surgery becoming necessary. There are no subjective urinary symptoms and in the majority of cases the urine remains normal. There is usually a polymorphonuclear leucocytosis, varying in degree, but conforming generally with the course of the fever.

From the point of view of both prognosis and treatment it is important to divide the cases into two groups, the septicemic and the non-septicemic. In the former, rigors, a quick pulse, multiple metastases, and an evidently grave illness overshadow the local signs of perinephritis. In the latter, rigors beyond an initial chill are unusual; the pulse rate remains slow in proportion to the temperature, and the renal abscess is usually the only metastasis to be discovered.

As in every other type of suppuration, there is an optimum moment for operation. Too early or too late interference may do harm. As a general principle, when the symptoms and signs suggest an established collection of pus outside the kidney, a deep incision into the loin, exploration with the finger, and simple drainage are all the measures that are required. It is not uncommon, even in the presence of such symptoms and signs, to find no pus but only a hard, indurated condition of the perinephritic fat. Whether or not pus later finds its way along the track, improvement may start from this moment. The author has never seen a case in which nephrectomy seemed justifiable. It has been undertaken, but usually should not be necessary. In the presence of suppuration around the kidney, there are clearly

undesirable risks and the possibility of initiating a secondary bacteriemia cannot be disregarded. Furthermore, a renal carbuncle may develop later in the other kidney.

In the stage of renal carbuncle without perinephritis (if the diagnosis can be made with sufficient confidence at this stage) an argument might be found for nephrectomy, but the loss of a kidney which rarely sustains more than partial damage, and the knowledge that in most cases simple drainage of the secondary perinephritic abscess is an adequate procedure favor conservatism. Local excision of the infected area and free incision into the actual renal carbuncle, even if feasible, are probably as inadvisable as the more active forms of treatment are now commonly held to be in the case of superficial carbuncles.

In the septicemic cases, in which the renal focus is only one of many and organisms persist in the blood, the prognosis is clearly that of the case as a whole.

In the non-septicemic cases, it may be said that there is good cause for conservative handling and no cause for undue pessimism.

HARRY W. PLAGGEMEYER, M.D.

Emmett, J. L., and Kibler, J. M.: Renal Tuberculosis: Prognosis Following Nephrectomy Based on Pre-Operative Observations in the "Good" Kidney. *J. Am. M. Ass.*, 1938, 111: 2351.

The indications for nephrectomy in the presence of renal tuberculosis are commonly discussed. Opinion on this subject is unsettled, partly because of the lack of agreement concerning the pathogenesis of the disease. The question today concerns how many of the usual tests should be employed and the finding of what manifestations relative to the so-called uninvolved kidney should be insisted on before the patient is subjected to removal of the involved kidney. For brevity the diseased kidney that was removed at operation will be referred to as the "bad" kidney, while the so-called uninvolved kidney will be spoken of as the "good" kidney.

The records of 1,131 consecutive patients on whom nephrectomy was performed for renal tuberculosis at the Mayo Clinic between the years 1912 and 1932, inclusive, were studied. The results in these cases have been studied from the standpoint of the observations made in the clinical investigation of the good kidney prior to operation. No patients were studied who were operated on after 1932, in order that all cases might be studied from the standpoint of at least five-year survival. Of the 1,131 patients, 453 were known to be dead. To the remaining 678 patients letters of inquiry were sent, and answers were received in more than 70 per cent of the cases. From the information obtained, the following classification of results was formulated:

1. Deaths.
2. Patients cured.
3. Patients benefited. These were patients whose vesical symptoms had diminished since operation but in whom vesical symptoms of some kind, even though slight, still persisted.
4. Patients not benefited.
5. Condition unknown.

The number of cases in which nephrectomy has been performed at the clinic each year since 1912, for renal tuberculosis, indicates a definite reduction in the incidence of this disease. The average age of the patients operated on varied little from year to year during the twenty years of the study and there was essentially no difference in postoperative results among patients of the various age groups. The disease affected almost twice as many males as females. That the disease is far more serious to the male is shown by the fact that in the study of ten-year survivals almost twice as many males as females had died, whereas the incidence of cure among females was strikingly higher than it was among males. The 1,131 patients were divided into four main groups as follows:

Group 1. Patients whose good kidney was not catheterized prior to operation.

Group 2. Patients whose good kidney was catheterized prior to operation, and microscopic examination of the centrifuged ureteral specimen of urine revealed either no pus cells or not more than 3 pus cells per high power field.

Group 3. Patients whose good kidney was catheterized prior to operation and microscopic examination of the ureteral specimen of urine revealed from 3 to 10 pus cells per high power field.

Group 4. Patients whose good kidney was catheterized prior to operation and microscopic examination of the ureteral specimen of urine revealed more than 10 pus cells per high power field.

In an effort to evaluate the importance of investigating the good kidney by the inoculation of guinea pigs and acid-fast staining of the urine obtained by ureteral catheterization, each of Groups 2, 3, and 4 was broken down into Divisions A, B, and C. Division A indicated that guinea pigs were not inoculated and that positive acid-fast stains were not obtained. Division B indicated that guinea pigs were inoculated but that the results were negative and that positive acid-fast stains were not obtained. Division C indicated that either the test by inoculation of guinea pigs or acid-fast staining, or by both methods, gave positive results.

What, then, can be deduced from the information derived from a study of the comparative results in these various groups of cases, and in what way can the deduction assist in the diagnosis and plan of treatment in renal tuberculosis? In the first place, to make a fairly accurate prognosis, catheterization of the good kidney, to determine the amount of pus being secreted, is imperative. A negative urine in such a case leads to a favorable prognosis and the authors' statistical data indicate that the patient may expect approximately a 43.5 per cent chance of a five-year cure, a 65.2 per cent chance of being cured or benefited in that period, and only a 20.3 per cent chance of death within five years. If, in addi-

tion to this, inoculation of a guinea pig gives a negative result and a positive acid-fast stain is not obtained, his chance of dying within five years will drop to 13.3 per cent, his chance of a five-year cure will be increased to 50.3 per cent, and his chance of being either cured or benefited will increase to 75.2 per cent. On the other hand, if the guinea-pig test is positive, the patient's chance of dying within five years increases to 41.8 per cent, and his chance of a five-year cure drops to 21.8 per cent.

The question then arises, should a positive guinea-pig test, corresponding to the good kidney, in spite of absence of pus in the urine, be considered a contraindication to surgical operation? It must not be forgotten that 21.8 per cent of the patients with such results were cured, and that a total of 36.4 per cent were either cured or benefited at the end of ten years. Certainly almost any one who had the disease would be willing to submit to operation if given a 30 to 36.4 per cent chance of improvement for from five to ten years.

When pus is found in the catheterized specimen of urine from the good kidney, the problem is radically altered. Because of the small number of such cases in this series it is difficult to make as far-reaching statements as have been made concerning the cases in which the urine was microscopically negative. However, the data suggest that if more than 3 pus cells per high power microscopic field are found and the guinea-pig test or the stain is positive, the prognosis is poor and it is questionable whether operation is warranted. If there is a small amount of pus, if the guinea-pig test and stains are negative, and if the excretory urogram is normal, the prognosis seems to be reasonably good and possibly surgical measures are worth the trial.

One might well ask whether this study sheds any light on the old arguments concerning the question whether renal tuberculosis is essentially bilateral and whether healing ever takes place in renal tuberculosis. Comparing the groups and divisions 2C, 3C, and 4C, it is seen that in Group 2C there is a considerably higher percentage of five and ten-year cures, in spite of the positive guinea-pig test. There are fewer five and ten-year cures in Group 3C but still a fair number; whereas in Group 4C there are no five or ten-year cures. Group 4C, including as it does the cases in which guinea-pig tests or stains were positive and a considerable amount of pus was present, no doubt represents advanced lesions which probably are those which Thomas would classify as destructive lesions. In these cases progress would be expected to be poor. The recovery of patients in Group 2C and Group 3C, however, is not so easily explained. No doubt the positive finding in some cases is due to the reflux of vesical urine up the ureter, or it may be attributable to the catheter, as it is passed through the bladder, picking up bacteria and pus. However, certainly some of these cases must have been true cases of bilateral renal tuberculosis. That the lesion in the kidney became quiescent or healed clinically seems probable, although of course a conclusion cannot be reached unless the kidney is examined microscopically. It is believed that on the basis of the statistics, which are drawn from a relatively large group of cases, it should be possible for the physician, after a complete study of the good kidney, including urography, to give his patient a fairly accurate prognosis.

Van Der Vuurst De Vries, J. H. J.: The Usefulness or the Necessity of Subsequent Examinations of Patients in Whom Bilateral Renal Tuberculosis Has Once Been Found (De l'utilité ou de la nécessité des explorations successives chez les malades chez lesquels on a constaté à un moment donné une tuberculose rénale bilatérale). *J. d'urol. méd. et chir.*, 1938, 46: 526.

Microscopic examination of cases in which the circulation of tubercle bacilli are found circulating in the blood has shown that renal tuberculosis is always bilateral and that the so-called tuberculous bacilluria of a healthy kidney does not exist. The diagnosis of bilateral renal tuberculosis requires the presence of a number of well known symptoms and imposes the necessity of cystoscopy, with a separate collection of urine from each kidney, especially when most of the symptoms are absent. Cystoscopy may reveal tuberculous lesions of the bladder, principally around the ureteral orifices, but their absence does not disprove the presence of renal tuberculosis. Cystoscopic examination offers three possibilities: both ureters can be sounded, only one ureter can be sounded, and neither ureter can be sounded.

In the first case, the presence of pus and of tubercle bacilli demonstrates bilateral renal tuberculosis, while the urea and chloride concentration and the percentage of elimination of phenolphthalein indicate the degree of involvement of each kidney. When tubercle bacilli cannot be demonstrated for one kidney which discharges pus and shows a decrease in function, bilateral renal tuberculosis is probable. The phenomenon of inhibition may offer difficulties, but it occurs only in a healthy kidney: urography or repetition of the functional examination a few days later will prevent errors of interpretation. Bilateral pyelography will reveal the extent of the lesions.

In the second case, the diagnosis of the non-catheterized side becomes more uncertain because the urine of this kidney must be collected by means of the vesical catheter and various sources of error may be present (vesical lesions, admixture of urine of the contralateral kidney, epididymitis, or vesiculitis). However, the results of the functional examination may guide the diagnosis: if the rates for the urine collected by the vesical catheter are decidedly higher than those obtained for the catheterized kidney, the lesions of the former kidney are less serious than those of the latter, while if the rates are about equal or lower than those obtained for the catheterized kidney, the lesions are bilateral and it is even possible that the function of the former kidney is totally abolished. Pyelography of the catheterized side is always indicated.

In the third case, either cystoscopy or ureteral catheterization may be impossible, but urography may furnish information on the function of the kidneys: it is always necessary to include the kidneys and the bladder in the same roentgenogram. If the image does not allow interpretation, it is advisable to improve the condition of the bladder by appropriate treatment in order to permit subsequent cystoscopy.

As the microscopically proved primary bilaterality of renal tuberculosis does not correspond to the large number of cases of clinical unilaterality, the possibility of healing of small lesions of renal tuberculosis is evident. It is therefore necessary to distinguish advanced chronic tuberculosis, which leads to destruction, from the small early lesion, which may heal spontaneously or following treatment.

Treatment of bilateral renal tuberculosis consists of the usual general treatment and of specific treatment, with Vaudremer's vaccine, methylene blue given orally and by instillation, and instillations of gomenolized or phenolized oil. When unilateral healing has been demonstrated by repeated cystoscopies with functional examination of the kidneys, it is often found that the still diseased kidney is in worse condition than previously: nephrectomy is then indicated. Repeated examinations are necessary in all cases of bilateral renal tuberculosis in order that the opportune moment for surgical intervention is not overlooked.

Five cases are reported to illustrate these statements. RICHARD KEMEL, M.D.

Ball, Sir G.: Staphylococcal Infections of the Kidney. *Brit. J. Urol.*, 1938, 10: 323.

Staphylococcal infections of the kidney are relatively rare and when found they usually involve the cortex, although infection of the pelvis is from time to time associated with stone formation. The cortical lesions are hematogenous in origin and are commonly secondary to affections of the skin, such as furuncle and carbuncle, although suppurating foci in other parts of the body may be responsible.

Three types of staphylococcal lesions are recognized: (1) multiple minute abscesses studded throughout the renal cortex, seen in cases of severe acute pyemia associated with such diseases as acute osteomyelitis; (2) a superficial triangular septic infarct, just under the renal capsule; and (3) the lesion commonly found deep in the cortex known as "renal carbuncle," which results in persistent fistula formation after drainage of the perinephric abscess and will not heal until the kidney is removed, or, if it heals, will be followed by a recurrence of symptoms.

The author presents 4 cases to illustrate the clinical course and the difficulty in making a diagnosis of an early lesion. He advises that if a perinephric abscess has already formed, as is most commonly the case, it should be drained in the hope that the whole lesion will heal; but if healing does not occur within a very short period or if drainage of the abscess fails to lead to complete improvement in the general health of the patient, nephrectomy must be performed as soon as possible provided the opposite kidney is sound. D. E. MURRAY, M.D.

Hyman, A., and Wilhelm, S. F.: The Differential Diagnosis of Renal and Suprarenal Tumors. *J. Urol.*, 1938, 40: 737.

Frequently the first sign of a renal or suprarenal tumor is a palpable mass, with resulting pain in the lower chest, loin, and upper abdomen. Adjacent structures and organs, such as the kidney and the diaphragm, may be dislocated and even infiltrated. The tumor is not uncommonly detected by a shadow in the flat x-ray film, or it may be suspected because of its effect on the position of the kidney, which is displaced downward, mesially, or laterally. Displacement on the left side is particularly significant since the kidney on this side is seldom found out of its usual location. Retrograde and excretory pyelography sometimes reveals compression and distortion of the upper and middle calyces. Slight deformities, such as flattening or absence of a minor calyx, may be the only roentgenographic sign of a large tumor. Excretory urograms are made routinely in both the Trendelenburg and reverse Trendelenburg positions, to show the degree of renal mobility (normally 2 to 5 cm.). Fixation of the kidney has been reported in cases of perinephritis and renal suppuration and also of infiltrating carcinoma. Perirenal insufflation has been employed to visualize suprarenal tumors, but it has not been found to be an innocuous procedure, and the information obtained therefrom is often of limited value, and may be misleading.

For practical purposes, the following terms have been adopted: (1) cysts; (2) inflammatory exudate or abscess; (3) neoplasm of the upper renal pole; (4) neoplasm in the suprarenal region, (a) arising from the suprarenal gland, and (b) not arising from the suprarenal gland; and (5) splenic enlargement.

A number of cases are reported. The first was that of a woman, aged sixty-seven years, who complained of pain in the left lower quadrant, sticking pain in the right lower chest, and frank hematuria. The left side of the abdomen was entirely filled by a large, movable, non-tender mass, and a rounded ballottable mass, the size of a lemon, was felt attached to the lower pole of the right kidney. Roentgenography revealed a large circular shadow at the upper pole of the left kidney, and a smaller round shadow near the lower pole of the right kidney. Operation revealed 2 large cysts, one at the upper and one at the lower pole of the kidney.

Case 2. A man, aged fifty-nine, had frank hematuria and the stigmas of eunuchoidism. Roentgenography revealed a stone in the lower pole of the right kidney; cystoscopy revealed bloody urine from the left side; renal function was good; and retrograde pyelography showed downward displacement of the pelvis and some dilatation. A suprarenal tumor was suspected, but operation revealed a large cyst at the upper pole and a calculus in the lower calyx.

Case 3. A man, aged sixty-eight, complained of constant pain in the left loin, nocturia, cloudy urine, and frequent attacks of chills and fever. Examination revealed marked shock tenderness in the left renal region; x-rays showed the left kidney to be enlarged and low in position; and retrograde pyelography revealed marked ptosis and flattening of the upper calyx, which suggested an extrinsic mass above. The left kidney appeared fixed. Perirenal insufflation showed absence of air above the kidney. Operation revealed an abscess cavity.

Case 4. A man, aged fifty-five, complained of pain on the right side, weakness, loss of appetite, and marked loss of weight. The abdomen was distended and a superficial fluctuating mass was felt in the right lumbar region. There was moderate shock tenderness over the right loin, and moderate fever. X-rays showed obliteration of the right psoas shadow, and slight lumbar scoliosis with the concavity to the right. Pyelography revealed downward and inward displacement of the kidney, with normal pelvis and calyces. The ureter was also displaced mesially. A retroperitoneal abscess was diagnosed and was found at operation extending upward to the diaphragm.

Case 5. A woman, aged forty-one, had pain in the right loin and intermittent hematuria. A ballottable mass was felt in the right upper quadrant and loin, with slight costovertebral tenderness on the right side. Renal function on the right side appeared diminished. Pyelography revealed downward displacement of the right kidney and absence of the upper and middle calyces. Since the patient had previously been operated upon for retroperitoneal fibrosarcoma involving the left ovary, a diagnosis of metastatic fibrosarcoma in the suprarenal region (either displacing or infiltrating the kidney) was made. At operation, a sarcoma of the upper pole of the kidney was found to be extending into the renal vein and vena cava. Pathological examination revealed a spindle-cell sarcoma.

Case 6. A man complained of pain on the left side of the abdomen and back, of night sweats, and moderate fever for a period of three weeks. A hard, resistant, ballottable mass was found in the left lumbar region and in the left upper quadrant. Retrograde pyelography revealed deformity of the upper calyces with flattening. The left kidney showed some mobility. Operation revealed an entirely retroperitoneal mass, arising from the upper pole of the left kidney. Section of the tumor showed the Grawitz type of clear-cell carcinoma with involvement of the renal vein.

Case 7. A woman, aged forty-two, had suffered pain in the right loin which radiated to the groin for a period of one year. Two years earlier she had noticed a lump in the right lumbar region, which had increased in size. She also had frequency of urination. A hard, fixed mass was felt just below, and apparently adherent to, the right twelfth rib in the anterior axillary line. There was a hard, irregular, somewhat tender, ballottable mass in the right side of the abdomen, extending from the costal margin to the iliac crest. X-rays revealed a large calcified mass in the right upper quadrant, displacement of the kidney mesially and downward, and compression of the pelvis and calyces. Operation revealed the presence of a huge retroperitoneal osteochondromyxosarcoma.

Case 8. A woman, aged thirty, felt a constant boring pain in the left loin for months, but had no urinary symptoms. The left kidney was palpable, but was neither tender nor enlarged. The cystoscopic findings were negative. Pyelography revealed ptosis of the left kidney with fixation. Operation revealed a low kidney with a hard tumor mass directly above it, but distinctly separated. The neoplasm was obviously malignant and inoperable, since it proved to be a clear-cell carcinoma with necrosis.

Case 9. A man, aged twenty-three, had pain in the left flank, and fever. Pyelography showed a stricture of the lower ureter and absence of the superior calyx. The urine was bloody, and moderate fever was present. Ureteropyelography showed dilatation of the ureter and an abscess of the superior calyx. Colon bacilli were found on culture of the urine. Renal tuberculosis was diagnosed and, upon operation, a firm adherent mass was found at the upper pole. Pathological examination revealed a pheochromocytoma invading the upper half of the kidney.

Case 10. A woman, aged fifty, complained of pain in the right side of the abdomen, radiating to the hip, the lumbar region, over the sacrum, and the lower chest. She complained also of weakness, dyspnea, and nausea. A large mass was palpated in the right upper quadrant. Pyelography revealed marked downward displacement of the right kidney by a large mass above it. The renal function and outline were normal. The calyces were normal also, except that there was slight dilatation of the lowest one. At operation, a large inoperable carcinoma arising from the cortex of the right suprarenal gland was found.

Case 11. A man, aged sixty-five, complained of loss of weight, recurrent hemorrhoids, and chronic constipation. A left abdominal tumor was felt about one year previously. There was slight nocturia but no other genito-urinary symptom. A large, smooth, non-tender mass was felt in the left side of the abdomen. The mass moved with respiration and a distinct notch was palpable. The liver was palpable and smooth. The left epigastric vein was prominent. Urinalysis was negative except for a trace of albumin and rare leucocytes. Pyelography revealed considerable downward and medial displacement of the left kidney by a large mass which could be seen above. The pelvis and calyces were slightly dilated. Urine from the left kidney showed few leucocytes and many erythrocytes. The final diagnosis was cirrhosis of the liver with marked splenic enlargement which dislocated the kidney.

LOUIS NEUWELT, M.D.

Hunner, G. L.: Intussusception of the Ureter Due to a Large Papilloma-Like Polypus. *J. Urol.*, 1938, 40: 752.

A case presenting two features which are unique in urological literature, intussusception of the ureter and polypoid tumor of the ureter, is presented.

A woman, aged thirty-three years, had attacks of pain in the region of the right mid-anterior flank for four years which recurred at monthly intervals. Palpation over the lower pole of the right kidney elicited tenderness, as did pressure over the right ureter at the pelvic brim. There was tenderness over the right ureter in the region of the broad ligament. The urine was normal except that it contained a considerable amount of albumin. Cystoscopy revealed a normal bladder except for the right ureteral orifice, which was large, and the presence of a papilloma-like mass with a pedicle and glistening finger-like branches. Catheterization of the right ureter showed complete blockage at about the level of the pelvic brim. Urography showed two small areas of increased density in the ureteral line just to the right of the fourth lumbar vertebra. The catheter tip rested at about 1 cm. below the dense shadows which were interpreted as ureteral calculi. The right kidney was in good position and of about normal size, but none of the sodium iodide passed the level of the catheter tip. There was some dilatation of, and some convolutions in, the lower abdominal ureter. The pelvic ureter was widely dilated and its lumen was occupied by a mottled, feathery shadow, suggesting that the papillomatous condition had originated from a large ureteral tumor mass. The papillomatous mass projecting from the ureter was fulgurated. Attempts to pass a renal catheter beyond the obstructing area (supposedly harboring the ureteral calculi) failed. Intravenous urography nine months later failed to show the shadows that were suggestive of stones, and it was concluded that they had passed spontaneously. However, the intermittent attacks of pain persisted.

The subsequent examination revealed the right kidney to be palpable over its lower third, of normal size and mobility, but moderately tender. There was tenderness and a desire to void on pressure over the right ureter at the pelvic brim. Pressure over the lower ureters in the broad ligament regions revealed marked tenderness and a desire to void. Vaginally and rectally, no unusual resistance was detectable. The urine was practically clear and contained no unusual clumps suggesting fingers of papilloma. Cystoscopy revealed no papilloma implants in the bladder. The right ureteral orifice appeared normal, but there was a bullous edema nodule just to the median side of the orifice. There was some prominence of the ureterovesical wall just back of the orifice, but this was not prominent enough to arrest attention had it not been for the previous ureterogram suggesting a distention of the lower ureter with a tumor. A 15 F. dilating bougie could be passed 24 cm. beyond the external ureteral orifice, but returned with a long curve in the distal end as

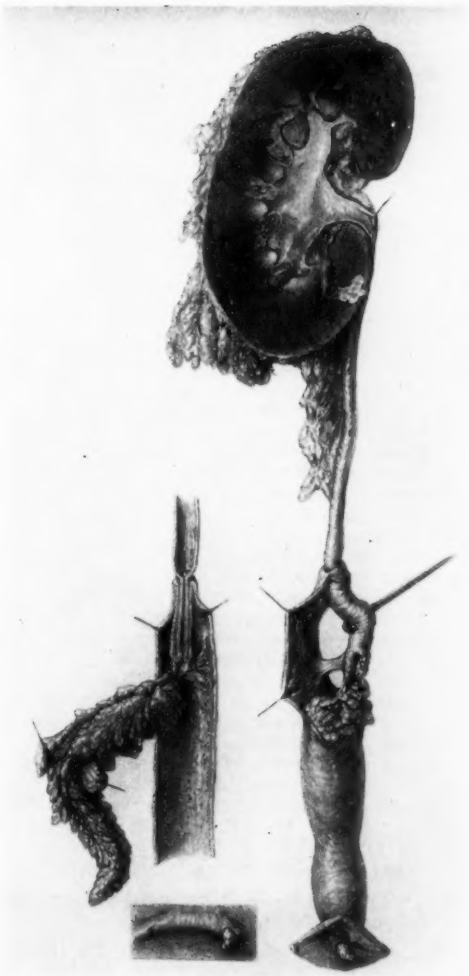

Fig. 1. *A*, Drawing of gross specimen; kidney bisected; ureter opened over region of intussusception. *B*, Ureter opened to show mechanism of the intussusception; base of the tumor attached to neck of intussusceptum; adhesions connecting neck of intussusceptum to posterior wall of the intussuscipiens. *C*, Cystoscopic appearance of ureteral orifices with patient in knee-breast position.

though it had doubled back on itself. A ureteral catheter with a 15 F. wax bulb was then placed about 12 cm. back of the tip and soon after the bulb disappeared within the ureteral orifice the catheter was abruptly blocked. The intravenous differential phthalein test showed normal values. Fluids introduced into the catheter for urography refluxed rather

promptly through the bladder catheter, showing that little or none of the injection reached the kidney. The catheter tip apparently had been blocked by a ureteral convolution (Fig. 1), somewhat above the pelvic brim, and some of the solution had passed the tip for about 3 cm., but passage was completely blocked near the lower edge of the fifth lumbar transverse process. At the upper edge of the fifth transverse process there were two small dense shadows similar to those seen previously and interpreted as ureteral calculi. The pelvic ureter was widely distended and showed the same mottled appearance seen previously. Later cystoscopy still revealed no evidence of papilloma implants in the bladder. The right ureteral orifice opened from 2 to 4 mm. in diameter with each peristaltic wave, and occasionally a small, pale, jelly-like polypoid mass projected through the orifice just beyond the level of the bladder mucosa.

At operation, a complete aseptic nephro-ureterectomy through two relatively short incisions (Edwin Beer method) was done, followed by an uneventful convalescence. Figure 1 presents the appearance of the removed specimen. Only after the mid-portion of the ureter was opened was it realized that this was a case of intussusception of the ureter. The invagination was due to the drag of an unusually large papilloma-like tumor. Microscopically, this tumor was a pure polypus. The history of intermittent attacks of moderate pain for four years suggests that the intussusception was of long standing. The tumor plus the intussusception had led to astonishingly little damage to the kidney. Had the ureter been explored first, the rather solid feeling mass at the site of the intussusception with dense adhesions surrounding the ureter in this region, would have suggested the diagnosis of "probable malignancy" and the entire tract would have been removed from below upward—a distinctly more difficult procedure.

LOUIS NEUWELT, M.D.

BLADDER, URETHRA, AND PENIS

Blair, V. P., and Byars, L. T.: Hypospadias and Epispadias. *J. Urol.*, 1939, 40: 814.

The authors describe their method of plastic repair, which has in their hands most nearly reproduced the natural condition, reduced the average number of steps of operation, and eliminated much of the uncertainty of the results.

The article is fully illustrated and the technical details can be obtained from the illustrations and the accompanying legends.

The operative plan consists of three steps:

1. The correction of the deformity and the freeing of the corpora cavernosa. The ventral skin defect is covered by skin from the dorsum and lateral surfaces of the penis.

2. The urethra is formed from this transposed skin and covered with skin from the scrotum.

3. The penis is freed from the scrotal flap and the urethra completed.

The procedures for lesser degrees of hypospadias and for epispadias are also illustrated in detail. Pressure dressings are used after each step.

ANDREW MCNALLY, M.D.

Hansson, C. J.: Cancer of the Penis and Its Treatment. *Acta radiol.*, 1938, 19: 443.

The author analyzes the cases of 73 patients who were accepted for treatment at the Radiumhemmet, Stockholm, out of the 106 who presented themselves during the years of from 1912 to 1937. Of the 73 patients treated, 27 were seen within the past five years and therefore their cases are not included in the discussion of the results of treatment. These cases are divided into three groups, based on the findings in the regional lymph nodes at the beginning of treatment.

Group I. Cases without clinically demonstrable lymph-node metastasis. This group comprises 27 patients, 23 of whom are symptom-free after five years. Treatment in this group varied from irradiation only to amputation with dissection of the lymph nodes followed by irradiation of the surrounding region.

Group II. Cases with clinically demonstrable lymph-node metastasis when the cancer is clinically limited to the nodes. There were 12 patients in this group with 7 patients symptom-free for five years. The same kind of treatment was used as for Group I with satisfactory results only from the more radical type; that is, amputation with dissection of the lymph-node areas followed by irradiation.

Group III. Cases with lymph-node metastasis when the cancer has begun to break through the lymph-node capsule. There were 7 patients in this group, in all of whom the treatment was merely palliative.

The author stresses the fact that combined surgical and radiological therapy offers the greatest prospect of success.

ANDREW MCNALLY, M.D.

GENITAL ORGANS

Moszkowicz, L.: False and True Cryptorchidism (Ueber falschen und echten Kryptorchismus). *Arch. f. klin. Chir.*, 1938, 192: 209.

The disagreements in the literature with respect to the genesis and the treatment of cryptorchidism are attributed to the fact that quite different conditions have been included under the term "cryptorchidism." A differentiation must be made between true and false, or pseudo, cryptorchidism. In the latter, we are dealing simply with a residual patency of the processus vaginalis, through which the small testicle is able to slide back and, in the presence of excessive adiposity (especially in the temporary type of adiposogenitalis), the testicle may become completely hidden. At the time of puberty such testicles usually tend to become larger and then descend spontaneously to the normal position. Furthermore, such testicles which ordinarily are not hypoplastic tend to undergo volvulus and necrosis.

In these cases operation may be deferred until the time of puberty when these testicles can easily be brought down to the proper position.

In contradistinction to this condition, in true cryptorchidism the testes are primarily undeveloped and can be brought down only with great difficulty or not at all. Now since both forms are, ordinarily, not differentiated the operative results are reported with great variation. Ideal permanent results, in 80 per cent of the cases, as well as highly unsatisfactory results have been reported. It may be mentioned right at this point that the endocrine treatment up until the present time has not yielded any uniform results.

The author then enters into a prolonged, richly illustrated discussion of the descensus, the inhibition of the latter in both the female and the male embryo by means of intersexuality, and the relationship of the descensus to hermaphroditism, eunuchoidism, and infantilism. The development of true cryptorchidism is explained on the basis that the male differentiation has passed through a female developmental phase in an abnormal manner, and a ligamentum latum was formed which causes both of the testicles to become fixed to each other; this developmental abnormality can be demonstrated anatomically. The findings in tumor formation in the undescended testicle are notable. Formerly, it was assumed that a dystopic testicle underwent malignant degeneration more frequently than the normally situated one. This conception has been disputed in recent times. However, an unequivocal decision of this question, according to the author, is possible only if the clinician from now on is careful to differentiate between true and false cryptorchidism.

From the anatomical point of view, de Barry and Fischer-Wasels (1933) maintain that the retained organ is the seat of a malignant neoplasm from 150 to 200 times as frequently as the normally situated one. Very important is the fact that most of the tumors are found in a particular group of individuals who possess the characteristics of the intersexual type. It is strongly recommended that the name dysgerminoma (Robert Meyer) be introduced to designate this type of tumor. The term seminoma is refuted.

In false cryptorchidism, treatment may be deferred until the time of puberty. In the cases of inguinal hernia, conservative operation is indicated, but not too early. In true cryptorchidism, the hypoplasia of the testicle can be improved neither by operation nor by endocrine therapy. In spite of this, operation should be performed (orchidopexy). If operation proves unsuccessful in bringing the testicle down and fixing it, the testicle should never be replaced into the abdomen but should, if the condition is unilateral, be removed because of the danger of malignant degeneration.

In many cases of cryptorchidism potency and the libido may be either altered or normal, and occasionally they are increased. Marriage can hardly be interdicted; however, the partners in marriage should be informed concerning this condition, that it is a symptom of degeneration, and hereditary; furthermore, that the male partners (even in the cases of unilateral involvement) are often sterile.

(Roedelius). Harry A. Salzmann, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Geschickter, C. F., and Maseritz, I. H.: Ewing's Sarcoma. *J. Bone & Joint Surg.*, 1939, 21: 26.

The roentgenographic appearance of Ewing's sarcoma afforded a comparatively positive means of diagnosis in more than 70 per cent of the 135 cases used as the basis of study for this report on the diagnostic features of Ewing's sarcoma. The diagnosis in the last analysis necessarily depends upon the microscopic findings.

The roentgenographic appearance of Ewing's sarcoma and subacute and chronic osteomyelitis may resemble each other very closely. The combined effects of bone destruction, periostitis, and reactive bone formation in osteomyelitis produce many roentgenographic findings similar to those seen in Ewing's sarcoma. Ewing's sarcoma is an invasive tumor which tends to extend longitudinally along the shaft of bones; it invades the medullary cavity and destroys the bone spicules. In response to this invasion and destruction, new bone is laid down subperiosteally and subendosteally. The tumor tissue possesses no properties of osteogenesis. The ratio of bone destruction and new bone formation is variable and inconsistent. This produces variable roentgenographic appearances. The so-called onion-peel formation in Ewing's sarcoma is the result of multiple parallel rows of reactive bone separated by tumor tissue. Often the extent of bone reaction is proportionally greater than the speed of tumor growth, which results in a broad sclerotic shaft. The cause of sclerosis is an encroachment of the reactive bone on the soft tissues surrounding the cortex and on the medullary cavity which tends to become obliterated. The tumor tissue will often overcome this defensive mechanism and grow outward from the periosteal covering, forming a soft tissue mass which is surrounded by a thin wall of connective tissue. Transverse striations may develop. Great similarity is often found in such clinical factors as age, sex, race, mode of onset, duration of symptoms, and physical findings. Biopsy studies are frequently necessary to make the diagnosis.

Roentgenographic appearances of sclerosing osteogenic sarcoma seldom present serious difficulties in a differential diagnosis from Ewing's sarcoma because the roentgenographic appearance of patchy sclerosis and irregular ossification in the periosteal zone are sufficiently constant in sclerosing osteogenic sarcoma to be considered pathognomonic. The roentgenographic changes in early growths do not present these features so distinctly, but they are sufficiently characteristic that they can be distinguished from the changes in Ewing's sarcoma. The bone involvement in sclerosing osteogenic sarcoma is usually confined to a limited area of the distal portion of a shaft and gives one the impression of a tumor formation. This is not true of Ewing's sarcoma, which most often involves from one-third to one-half of the shaft. The transverse striations that are occasionally present in Ewing's sarcoma are fine, hair-like, and resemble groomed whiskers; those seen in sclerosing osteogenic sarcomas are coarse and do not have the groomed appearance.

Osteolytic osteogenic sarcoma can usually be differentiated from Ewing's sarcoma by roentgenographic examination. The roentgenographic changes in chondrosarcoma simulated Ewing's sarcoma or osteomyelitis in several instances.

Microscopic and roentgenographic differential diagnostic features are discussed for other bone tumors. Photographs of roentgenograms and photomicrographs are presented.

The many microscopic forms of Ewing's sarcoma are apparently the results of variations in growth and in blood supply, rather than varying modes of histogenesis.

The individual tumor cells were found to vary as frequently as the mode of growth. The most common type encountered was the small or moderately large round or oval cell with little or no obvious cytoplasm. The reticulum cell was second in frequency, the spindle type of endothelial cell was third, and lymphocytic and myelocytic types were rare.

The prognosis is grave. Death occurred in 94 per cent of the cases in this series. The greatest problem is early and accurate diagnosis, which can be definitely determined only by biopsy. Irradiation, as a therapeutic test, should precede biopsy. Resection of the entire shaft, when possible, in proved cases is the operation of choice, except in the weight-bearing bones of the lower extremity, where amputation is advised. ROBERT P. MONTGOMERY, M.D.

Ortlepp, H.: Epicondylitis Humeri (Ueber Epicondylitis humeri). Kiel: Dissertation, 1938.

Vuillet published an article entitled "L'épicondylite" in *Semaine méd.*, 1909, No. 22. In Germany Francke followed with his paper, "Ueber Epicondylitis humeri," in *Deutsche med. Wchnschr.*, 1910, Nos. 1 and 9. The lesion is found usually on the lateral, seldom on the medial epicondyle. Frequently, a mild swelling in the form of a circumscribed edema and tenderness to pressure may be demonstrated. A tugging pain is elicited by pressing down upon the closed fist with the wrist held in dorsiflexion and the elbow completely extended. Active extension, however, may be limited to 160 degrees; extreme flexion may likewise be painful; the intermediate range of motion is free. A periosteal thickening is found roentgenologically only in more chronic cases, using oblique views and projecting the plane of the lateral epicondyle.

Vuillet believes that repeated hyperextension of the muscle groups arising from the epicondyle causes the lesion. In addition, nerves, periosteum, bursæ, joint capsule, cartilage, and bone become involved. Thomsen wrote, "If it is now a fact that in all cases of epicondylitis humeri passive motion of the hand with fingers extended, almost without exception, elicits no pain at the epicondyle and that, on the contrary, the same motion with the fist closed and the fingers in maximum flexion often causes very marked pain at the epicondyle, it demonstrates significantly that the extensor digitorum communis is primarily involved." Following Hohmann's operative procedure for such cases, Thomsen removed sections of muscle, in which Klinge demonstrated a definite microscopic picture of chronic inflammation. In 1910 Francke recommended chiseling off the epicondyle; in 1926 Fischer advocated cutting away the pain-producing periosteum. At the 21st congress of the Orthopedic Society Hohmann stated, "Through a small incision, I made a notch into the bone directly over the lateral epicondyle, and so relieved a genuine tension, while lengthening this portion of the muscle." Thereafter all complaints vanished. No loss of strength occurred. In the other cases he did not strip the entire condyle of muscle, but only the anterior projection and the groove lying laterally to it, the site of the greatest pain. Ten days of nursing must follow. Hohmann reported 4 cases, and in 1930, a total of 12 cases, in 11 of which results were immediately proved. Mau recommended this operation on the basis of 4 cases with follow-up. Boshammer and Thomsen also advocated this operation. On the other hand, Halla warned against keloid formation and delayed healing. The small number of published operations indicates that to the greatest extent treatment was conservative. Rest by use of a plaster or Cramer splint, baking, and massage also achieved results; Ortlepp treated 24 cases in this manner. If from four to six weeks of conservative therapy fail, the operation should be considered.

(Plenz). Jerome G. Finder, M.D.

Testa, G.: Disease of Sinding Larsen and Johansson (Malattia di Sinding Larsen e Johansson). *Radiol. med.*, 1938, 25: 1081.

About 30 cases of the Larsen-Johansson lesion are found in the literature. Testa describes 2 new cases in boys, aged thirteen and eleven years, respectively. The disturbance appears about the age of puberty (average age, twelve years) in children of normal development and of active life, generally without previous or coincidental trauma. The onset of the disorder is slow and gradual, marked by vague, intermittent, slight pains which do not interfere with function, but which are aggravated by physical exercise: they are practically never intense enough to force abstention from all activity and they usually involve only one knee. When both sides are involved, roentgen examination may reveal the presence of a dystrophic disorder, such as the lesions of

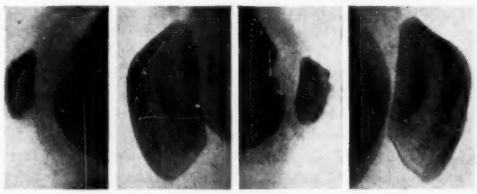

Fig. 1. Fig. 3. Fig 2. Fig. 4.

Figures 1 and 2. Female, aged six years, healthy. Patella of granular aspect, with dentations and fringes of the anterior contour.

Figures 3 and 4. Normal images.

Osgood-Schlatter or of Legg, Calvé, and Perthes. Generally, the apex of the patella and the point of attachment of the ligament are the seat of maximal pain and the initial symptoms have usually been present from two to six months before the patient comes under observation. A swelling may be found at the upper attachment of the patellar ligament or at the sides, and palpation or percussion at this point may reveal tenderness, but usually the subjective signs are slight. Active and passive movements are well conserved and the general condition is good. The disorder responds quickly to rest and immobilization and complete cure is obtained in from forty to sixty days.

Roentgen examination must take into account the age of the patient because ossification of the patella proceeds regularly even in the presence of remissions or recurrences of the clinical symptoms. However, the reported roentgen signs are unreliable because they may be found also in normal ossification of the patella; they have been found in children two or three days after injury and they are found on both sides in the same subject in whom the clinical symptoms are unilateral. The irregularities of the anterior patellar contour accepted as signs of erosion or destruction, the frontal or fronto-apical osseous lamella considered as a sign of periosteal reaction, and the more or less regular isolated nodule at the patellar apex are also found in the ossification of the normal subject (10 to 15 per cent). Besides, ossification presents marked differences as to time of appearance of the first osseous nucleus in the two sexes, and lobulated aspects with irregular contours are common in the first stages, as well as apical and frontal incisures and isolated nodules which may persist until the age of fourteen or fifteen years. It is consequently necessary to fall back on the histopathological findings and the clinical examination in the presence of a roentgenologically demonstrable accessory apical nucleus with osteochondrodystrophic disturbances which may predispose to abnormal irritative reactions under the influence of ordinary mechanical factors.

Histological examination excludes inflammation of tendon or bone and shows only slight infiltration of the vascular walls, some irregularity in the distri-

bution of the cartilaginous cells and in the presence of osteoid tissue and, in one case, aseptic necrosis of some osseous trabeculæ: these characteristics belong to the lesion of Osgood and Schlatter which seems to be present in 38 per cent of the reported cases. Clinically, there is also great similarity between the two disease forms in the matter of age incidence, benignity, duration, remissions, and recurrences. The disease of Larsen and Johansson is a syndrome in the pathogenesis of which must be considered mechanical causes acting as factors to produce chronic irritation of the patellar tendon and its osteocartilaginous plane of attachment; its causes are of circulatory character and are related to disturbances of nutrition. The accessory apical osseous nucleus is present before the clinical signs appear and favors the mechanical actions.

RICHARD KEMEL, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Berard and Bourdillon: Conservative Treatment of Pott's Disease in Children and Adolescents at the Hôpital Renée Sabran from 1931 to 1938
(Le traitement conservateur du mal de Pott chez l'enfant et l'adolescent à l'hôpital Renée Sabran, de 1931 à 1938). *Lyon chir.*, 1938, 35: 666.

Berard and Bourdillon report that at the Hôpital Renée Sabran at Giens, 118 children and adolescents with Pott's disease had been treated from January 1931, to May, 1938; of these 70 had been discharged and 48 were still under treatment at the time of their report, May 1938. Of the 70 patients who had been discharged from the hospital, 52 had been treated conservatively, without operation.

The lumbar vertebræ were involved in 42 per cent of these 52 cases, the thoracolumbar vertebræ in 8 cases, and the thoracic vertebræ in 13 cases. In most cases the disease had developed in early childhood, before the age of five years in 31 cases. Most of the patients were sent to the hospital while the disease was in an active stage, with the bone lesions well developed; only rarely were patients seen in the early stage; a few cases were seen after the activity of the disease had subsided, presenting only orthopedic sequelæ (deformity, gibbosity), or chronic suppuration and old fistulas. There were 10 patients in this chronic group. Of the 42 patients in the active stage of the disease, 9 had fistulas; 11 had Pott's disease associated with other tuberculous lesions; 22 had Pott's disease without other tuberculous lesions. Of the latter group only 8 had extensive lesions involving 3 or more vertebræ.

The therapy employed in these cases combined out-door and sun treatment with conservative orthopedic measures. Giens has a seaside climate, and is protected from north winds by mountains. The sun treatment was carried out according to Rollier's method, with gradually increasing exposures to the sun until the whole body was exposed—the duration of the exposures depending in each case on the patient's reaction as to temperature, weight, and appetite. The duration of the sun bath never exceeded two or three hours, and in the summer was still less. If the patients had fever, the sun treatment was suspended until the temperature became normal. The orthopedic treatment consists in strict immobilization of the spine in the correct position. As a rule the plaster bed of Calvé and Galland is employed, with minor modifications. Toward the end of the period of immobilization, the patient is allowed to assume the ventral position for certain periods each day, at meals and during the sun treatment. He is not allowed to get up until there is both clinical and radiological evidence of cure. Clinical evidences of cure are absence of pain and stiffness of the spine, with the development of slight compensatory curvatures above and below the involved vertebra. Radiologically, there is recalcification of the involved bone, which in the most favorable cases may result in a reconstitution of the spine "ad integrum"; in other cases, in a complete bony ankylosis of the vertebral bodies involved; and in still others in an incomplete ankylosis with reappearance of the outline of the intervertebral discs; this reappearance of the discs above or below the disease focus is a good sign of healing. The decision as to whether the child should wear an orthopedic corset after the period of complete immobilization depends upon the radiological findings. If there is a good bony callus or a *restitutio ad integrum*, such a corset is not necessary; if, however, there is only a partial ankylosis or a considerable loss of substance, a corset should be worn eighteen months or more. In association with heliotherapy and orthopedic treatment in these cases, a general medical treatment, with cod-liver oil or calcium gluconate given by injection, is advised especially during congestive exacerbations.

The results in these 52 cases as determined by a re-examination of the patients two or more years after discharge, or by a satisfactory report from the parents, are as follows:

In the 10 patients with non-active chronic lesions, there has been no change since discharge. Of 9 with fistula 2 were cured, 3 showed no change, and 4 have died. Of 11 patients with associated tuberculous lesions, 3 are cured, 3 show no improvement, 2 have grown worse, and 3 have died. Of the 22 patients with Pott's disease without associated lesions, 19 are cured (including all the 14 with a localized lesion), 2 present evidence that their condition has become worse, and 1 has died. From these results the authors conclude that for patients with Pott's disease with active tuberculous lesions elsewhere, the Mediterranean sea climate is not as favorable as the mountain climate and the Alpine sun. With uncomplicated Pott's disease, however, the sun treatment and the Mediterranean climate, combined with conservative orthopedic methods, appears to be the method of choice. Operative osteosynthesis is an adjuvant in certain selected cases.

ALICE M. MEYERS.

FRACTURES AND DISLOCATIONS

Giangrasso, G.: The Accelerating Action of Vitamin C on the Healing Process of Fractures (Azione acceleratrice della vitamina C sul processo di guarigione delle fratture). *Policlin.*, Rome, 1938, 45: sez. prat., 2279.

The metabolism of ascorbic acid in man is very active: an adult needs from 20 to 30 mgm. of this substance per day, of which he eliminates 10 mgm. in the urine. Vitamin-C deficiency leads to various disturbances, among which may be mentioned changes in the teeth and bones and a tendency toward hemorrhage. The metabolism of the bones is altered; disintegration of the cartilaginous cells is followed by osteoporosis and a tendency to fracture. Because of the curative action of Vitamin C in many diseases, the stimulation it exercises in many repair processes, and its specific action on the metabolism of the bones, Giangrasso determined to find out whether and how this substance influences the healing process of fractures.

All patients with fractures were examined to determine whether they were suffering from pre-existing or coexisting diseases; nearly all fractures were reduced under anesthesia; a plaster-of-Paris apparatus was applied in all cases, but complementary traction or surgical reduction was also needed in some of the cases. Roentgen examination was made on admission, after the fracture was reduced and then from time to time in order to follow the various stages of the process of repair. Vitamin C was given by the subcutaneous route: 50 mgm., equivalent to 1,000 international units, were given immediately after reduction of the fracture; and 100 mgm. were given every three days thereafter until healing was complete. Children were given one half of this dose.

Among a number of cases treated, only 3 are described which presented serious complicated fractures and were cured in about half the time usually needed for the healing of this type of fracture. In the second case, the dystrophic results of a progressive acute anterior poliomyelitis constituted another unfavorable factor. It is to be noted that fractures in both sexes and all ages are benefited by the administration of Vitamin C, which, in addition, neutralizes the deleterious action of some diseases on the formation of the osseous callus, for example, syphilis. The mode of action of Vitamin C in this case may be explained by the hypothesis that, as the essential localization of syphilis is in the walls of the blood vessels and as Vitamin C increases the vascular resistance by stimulating the elaborative capacity of the intercellular cementing substance of the vascular endothelium, Vitamin C neutralizes or at least compensates for the damage caused by the syphilitic infection. RICHARD KEMEL, M.D.

Plaut, H. F.: Fractures of the Atlas Resulting from Automobile Accidents. *Am. J. Roentgenol.*, 1938, 40: 867.

Present-day traffic hazards increase the incidence of fractures of the atlas. Such injuries are not as a rule the result of direct violence but are produced indirectly through the mechanical forces acting on the skull and spine. The anatomy, ossification, and variations of the first cervical vertebra are discussed by the author, following which 6 cases of fracture of the atlas are reported. The author has collected from the literature 99 cases of injury of this kind. Without an autopsy or at least a post-mortem roentgen examination, a more exact diagnosis is hardly possible in cases in which the injury is so extensive that death follows instantly. The opportunity to diagnose a fractured atlas with the help of roentgenograms is now greater than before the roentgen era. Direct trauma to the atlas is a rare accident. Fixation of the head and spine by contraction of the musculature plays a definite rôle.

In Table I of the original article the cause of the condition is given in 34 cases. The mechanism of the fractures is described. The author believes that blunt violence against the skull is the cause of atlas fractures almost without exception and that the 3 different mechanisms are: the atlantal squeeze, the lever-like action on the posterior vertebral arch, and the pressure of the odontoid against the anterior arch.

Table II gives the site of fractures in 88 cases. Associated injuries are represented by symptoms of skull fracture in the vault or base. More dangerous are those injuries loosening the anchorage of the first cervical vertebra.

Table III cites 75 complications. The medulla is seldom affected by fractures in its immediate neighborhood. If there are symptoms they range from "tingling" in the arms to sudden death. Coincident injuries are more frequently responsible for the majority of cord injuries than a separation in the atlas. Neuralgias with sensory disturbances in the region of the great occipital nerve are common.

In Table IV-A the author cities the nature of the accident, clinical signs of cord or nerve injury, the anatomical diagnosis, and results in 40 cases of isolated fractures of the atlas.

In Table IV-B he cites the same facts pertaining to 59 cases of complicated fractures of the atlas. General stiffness and pain in the neck, chiefly in the suboccipital region, are the main symptoms. The head may be held with both hands to prevent suffering from involuntary moments. Active flexion and extension during occipito-atlantal rotation and in the atlanto-axoid joints, and lateral inclination are inhibited by pain, and nodding may separate the fragments and elicit pain. Passive movements may hurt extremely and be somewhat limited. There is tenderness on palpation of the nuchal groove and also over the transverse process. Swallowing may be painful. The roentgen technique and findings are described in detail. Among conditions to be ruled out in the differential diagnosis are malformations, traumatic and spontaneous dislocations of the atlas, and injuries to the remainder of the cervical spine. Arthritis, osteomyelitis and tuberculosis, tumor, metastases, and diseases of the nervous system must be considered in the differential diagnosis. Treatment

is also described with special emphasis on immobilization, plaster casts, traction, and eventual operation. The treatment of complications is not discussed. Mortality and end-results are discussed, the author stating that the fatal results in recent years amount to only 9 per cent in fractures of the atlas. An overwhelming majority of the patients recover to full occupational activity. EMIL C. ROBITSHEK, M.D.

Griswold, R. A., Goldberg, H., and Joplin, R.: Fractures of the Humerus. *Am. J. Surg.*, 1939, 43: 31.

The authors use the traction cast, first advocated by Caldwell, as a means of fixation with traction, which in their hands has proved effective in the treatment of 128 cases of fracture of the humerus. Results were superior to those obtained with any other method.

Following gross reduction by manual traction and manipulation, a cast weighing from 3 to 4 lbs. is applied from the knuckles to the axilla. The forearm is placed in a position perpendicular to the line of the distal fragment and usually in semi-pronation. A sling about the neck suspends the cast from a plaster loop at the wrist, the effect being a pull in the line of the humerus by lever action.

In fractures above the insertion of the pectoralis major, the effect of this type of traction pull is to place the tendon of the long head of the biceps under tension and the head is swung into place.

In supracondylar fractures and fractures of the lower shaft, full pronation of the forearm is necessary inasmuch as the elbow is fixed in pronation. Attempts at supination result in a varus deformity.

In fractures of the shaft, this type of cast maintains reduction through the splinting action.

Circumduction exercises for the shoulder are permitted and will hasten convalescence. The proper sling length is important to avoid bowing of the fragments. LOUIS SCHEMAN, M.D.

ORTHOPEDICS IN GENERAL

Cornell, N. W., Bernheim, A. R., and Person, E. C. The Use of Hydrochloric Acid in Certain Cases of Atrophy and Delayed Calcification in Fractured Bones. *J. Bone & Joint Surg.*, 1939, 21: 40.

Clinical and roentgenographic observations in 5 cases of fracture with excessive bone atrophy and delayed calcification at the site of the fracture are reported.

The author believes that the bone atrophy in these cases is the result of a metabolic or constitutional disturbance which affects the intestinal absorption and subsequent utilization of calcium salts and therefore is responsible for the delayed union. The disturbance in absorption and utilization of calcium is due to a decrease or absence of hydrochloric acid in the stomach. Oral administration of hydrochloric acid, and a diet high in calcium and vitamins increases the absorption of calcium and furthers the calcification of bone.

The blood calcium content is seldom an indication of calcium behavior. The constancy of the blood calcium is maintained largely through the store of calcium in the bones. The calcium absorbed from the bones is not redeposited in bone. The calcium absorbed from the intestinal tract is deposited in the bones. A generous intake of calcium is therefore indicated in cases in which there is special need for deposition of calcium in the bones. In the presence of achlorhydria or hypochlorhydria, an increase in calcium and Vitamin D intake is insufficient for proper utilization of calcium and in these cases the addition of hydrochloric acid is indicated. The use of hydrochloric acid without a sufficient calcium intake may be harmful because hydrochloric acid increases the excretion of calcium.

There was no evidence of other disturbances associated with the deposition of calcium salts in the bones in the cases reported. The general condition of the patients and the local conditions at the sites of the fractures were satisfactory for union.

The following should be given daily to stimulate the deposition of calcium:

1. A high calcium and high vitamin diet.
2. Vitamin D (1,900 units U. S. P. XI).
3. Lactose (100 gm.).
4. Calcium lactose (40 gr.) or gluconate (80 gr.).
5. Hydrochloric acid (10 per cent solution), from 4 to 8 c.cm. in fluid three times a day with meals.

No food should be eaten between meals and the meals should be five hours apart.

ROBERT P. MONTGOMERY, M.D.

Maselli Campagna, V.: The Formation of Cartilage in Experimental Plastic Interventions on Joints with Free Autografts of Fascia Lata (La condrogenesi nelle artroplastiche sperimentali con auto-innesto libero di fascia lata). *Clin. chir.*, 1938, 14: 831.

The modern concepts of the surgical cure of ankylosis induced the author to study the question from a purely histological point of view and to investigate the behavior of the reticulo-endothelial system toward transarticular free autoplastic grafts. For his experiments he selected the knee joint of 2 groups of 5 rabbits each. In the first group, composed of young animals of the same litter, he completely excised the articular cartilage of both bones and interposed between the denuded bony heads a flap of fascia lata taken from the thigh of the operated side. The flap was fixed to the bones by means of 4 sutures and the joint was closed. In the second group, composed of adult animals, he excised not only the articular cartilage but also the capsular apparatus, and interposed between the bones a flap of fascia lata. The joint was closed and immobilized with a plaster-of-Paris bandage. The animals of both groups were killed at intervals of fifteen, twenty, thirty, forty, and fifty days after the intervention, and ten or fifteen days before being sacrificed they were given an injection of from 10 to 15

c.cm. of a 1 per cent solution of trypan blue in the marginal vein of the ear and in the subcutaneous tissues. The treated joint was removed with its capsular apparatus, fixed, decalcified, and stained for histological examination.

The first group revealed clearly the genesis of the cartilaginous metaplastic process in experimental resection of the articular heads. Undoubtedly, circulatory disturbances play an important part in osteogenesis and chondrogenesis, but the present experiments show that the graft of fascia lata finds a favorable site for its attachment and transformation into cartilage in the continued presence of synovial fluid and the peculiar nutrition by osmosis. The graft receives the full benefit of this nutrition, which allows it to undergo cartilaginous transformation. The reticulo-endothelial elements invading the resection take an active part in this slow but continuous transformation and many elements evolving toward the cartilaginous series demonstrate the accretionary genesis of many of these fixed cells which participate in the process of cartilaginous reconstruction of the new joint.

In the second group the histological picture presented only some variations in detail from that of the first group. In the preparation of animals killed fifteen and twenty days after the intervention, the periarticular sleeve, consisting of young connective tissue, showed a tendency toward perfect reconstruction of the articular capsule, and the reaction of the reticulo-endothelial system was early and intense; while in the animals prepared thirty and forty days after the intervention there was a veritable process of cartilaginous metaplasia of the newly formed connective tissue. There were numerous chondroblastic elements containing vitally stained granules and showing the accretionary origin of a large part of the cartilaginous cells. In animals prepared after fifty days the cartilaginous investment of the articular heads was practically complete and the articular capsule consisted of fibrous connective tissue showing distinct vital staining. The author concludes that arthroplasty with a free flap of living tissue in the treatment of ankylosis presents the advantage of facilitating the formation of the new joint by attachment of the flap, and of stimulating the reaction of the reticulo-endothelial system, the histocytic elements of which participate greatly in the differentiation of the various layers and tissues of the joint. Therefore, there is decided participation by the elements of accretionary origin in the repair of such cases as well as in cases which present fracture.

RICHARD KEMEL, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Wagner, W.: Observations and Treatment in So-Called Thrombosis of the Axillary Veins (Beobachtungen und Behandlung bei der sogenannten Achselvenenthrombose). *Zentralbl. f. Chir.*, 1938, p. 2169.

True thrombosis of the axillary or subclavian vein occurs but rarely in the so-called traumatic thrombosis of the axillary vein. Usually there is only a venous stasis as a result of mechanical obstruction to the venous outflow. On the basis of the well known observation of traumatic, segmentary arterial spasm and the contractility of the veins, the author comes to the conclusion that traction or tension of the axillary veins can produce a segmentary venous spasm and with it the corresponding states of stasis. At the same time it should be borne in mind that the axillary veins in their passage under the clavicle are firmly ensheathed by the coracoclavicular fascia and thereby more or less firmly fixed to the clavicle. A second such point of fixation is the passage of the subclavian vein over the first rib. At these points, functional spasm of the veins can occur at first with certain movements, such as of the arm. The result is first venous stasis and, with prolonged existence of the same, overdistention of the veins, edema, and induration of the surrounding fatty tissue. Pathological strands of fascia, the axillary arch of Langer or packets of glands, and tumors of callus, which are usually considered the cause of the venous stasis, are considered only as additional factors possibly favoring venous stasis.

The treatment required, therefore, is, first of all, the earliest possible and most rapid elimination of the primary vascular spasm in order to hinder the development of the secondary changes, such as overdistention of the veins. The treatment recommended includes the intravenous injection of antispasmodic remedies like eupaverin, repeated venesections, the application of leeches, and short-wave therapy. If secondary changes in the vein or its walls have already developed, only the surgical removal of the obstructions disturbing the outflow of blood can help. These observations are based upon 4 cases and 1 observation made by the author.

(VON BRANDIS). LOUIS NEUWELT, M.D.

Paschoud, H.: Some New Methods in the Prophylaxis of Postoperative Thrombophlebitis (Réflexions sur quelques nouveautés dans la prophylaxie de la thrombo-phlébite postopératoire). *J. internat. de chir.*, 1938, 3: 671.

Paschoud notes that the fact that thrombotic embolism may develop in an adolescent in good health after an operation for hernia not complicated by infection or fever tends to disprove some of the theories in regard to the causation of postoperative thrombophlebitis. In such a case there is neither a lesion in the vascular walls nor infection, which conditions have been considered causative factors in thrombophlebitis. The author's study of postoperative thrombophlebitis and of the most effective prophylactic measures has convinced him that the two factors necessary for the production of thrombophlebitis are a slowing up of the circulation, and changes in the composition of the blood.

On this basis he has found that the most effective measures to prevent postoperative thrombophlebitis are: the production of local hyperemia by the use of infra-red and sometimes ultraviolet irradiation before and during operation; and the rising of the patient several times a day immediately after operation. In cases in which some cardiac or other serious complication prevents this degree of activity, the patient is moved in bed frequently. Other important factors in the prevention of postoperative thrombophlebitis are the pre-operative preparation, the use of the newer anesthetics, the inhalation of carbon dioxide at the close of the operation, and the postoperative treatment. Important in the pre-operative and postoperative treatment are: the administration of saline and glucose by the drop method, either per rectum or intravenously; an alkaline vegetable diet; and a rich supply of vitamins, especially Vitamin C (redoxon given by injection when necessary).

In the five years in which these methods have been employed in the author's clinic at Lausanne, there have been but 2 deaths due to postoperative thrombosis and embolism, both occurring in 1938; during the period from 1934 to 1937, there was no fatal case of postoperative embolism, and the general surgical mortality has been reduced from 4.69 to 1.71 per cent.

ALICE M. MEYERS.

Horton, B. T.: The Outlook in Thrombo-Angiitis Obliterans. *J. Am. M. Ass.*, 1938, 111: 2184.

A total of 948 patients who had thrombo-angiitis obliterans were observed at the Mayo Clinic from 1907 to 1937, inclusive. These patients came from every state in the Union except 3 and from 10 foreign countries. More than 28 different nationalities were represented. Two hundred and sixty-two (28 per cent) of the patients were Jews; 686 were Gentiles. The same fundamental pathological process was present in all cases and the signs and symptoms, as well as the clinical course of the disease, were strikingly similar. Twenty-one of the patients were women, and the remaining 927, men; in other words, approximately 98 per cent of the patients were men. The mean age of the males was forty-one and eight-tenths years, of the females, thirty-eight and eight-tenths years.

Of the 948 patients in the series, 880 (93 per cent) were cigarette smokers. Of the 262 Jewish patients

88 (33.6 per cent) underwent amputation and of the 686 Gentile patients, 313 (45.6 per cent) underwent amputation. Thus, 401 of the 948 patients underwent amputation either at the clinic or elsewhere. Eighty-five patients underwent bilateral amputation of the legs; 16 were Jews, the others, Gentiles.

A study of amputations for periods of three, five, and ten years after the onset of the disease indicates that approximately 70 per cent of the patients will go without the necessity of amputation for a period of three years from the onset of the condition, whereas only 60 per cent will go for a period of five years, and only 40 per cent for a period of ten years.

Perhaps the most important factors which determine whether a person who has thrombo-angiitis obliterans will continue to walk on two feet throughout life are early diagnosis and thorough education of the patient concerning the nature of his disease and the care of his extremities.

BLOOD; TRANSFUSION

Touw, J. F., Nieuwenhuis, G., and Nauta, J. H.: Two Cases of Leucemia with Tumor Formation. *Acta med. Scand.*, 1938, 97: 376.

The authors present in detail 2 cases of leucemia with tumor formation. They note that among clinicians as well as among pathologists the problem of the nature of leucemia remains a moot question. Many investigators wish to make a rigorous distinction between leucemia and neoplasms; others point out the close connection existing between these affections.

The authors discuss in detail the history of the 2 patients in whom a connection between the leucemia and blastoma was strongly suggested. On the grounds of data from the literature, from anatomical experimentation, as well as from the pathological examinations reported herewith, they arrive at the conclusion that there is much evidence in favor of the classification of leucemia as a neoplastic disease.

Naegeli and Kaufmann considered leucemia as a hyperplasia of the leucocyte-forming system, that is, an increase in the number of cells without abnormalities in structure, metabolism, or function. Apitz concluded that the cells in leucemia do not fulfill the conditions of hyperplasia and pointed out the similarities between leucemia and neoplastic cells. These similarities may be given briefly as follows:

1. In neoplasia as well as in leucemia, the cells are atypical and the mitosis is anomalous.

2. Normal myeloid cells mature *in vitro*, unlike leucemia cells.

3. In hyperplasia the structure of the tissues affected remains intact, whereas it is destroyed in leucemia and neoplasia. The same picture may be found in the lymph glands in lymphatic leucemia and in lymphosarcoma. Chloroma, which according to Naegeli is a type of leucemia, may cause erosion of the skeleton; in this condition it is difficult to adhere to the theory of hyperplasia.

4. In leucemia, there is an independent formation of leucocytes, the cause of which is unknown. The same is true in neoplasia.

The authors note that certain investigators succeeded in producing a typical lymphatic leucemia in healthy guinea pigs by inoculation with a few live leucemia cells. Injury of the cells, or inoculation with filtrations of blood or lymph-gland emulsions always gave negative results. Many investigators independently produced leucemia in mice by means of subcutaneous benzol injections. When the injections were discontinued, the leucemia process went on undisturbed. This phenomenon is the reverse of what is seen in hyperplasia, in which the cells cease to increase when the exogenous stimulant is removed.

HERBERT F. THURSTON, M.D.

Howkins, J., and Brewer, H. F.: Placental Blood for Transfusion. *Lancet*, 1939, 236: 132.

The authors found that the average yield of blood from the placenta in 50 consecutive cases was 47 c.cm. as against 125 c.cm. reported by Goodall and 105 c.cm. obtained by Grodberg. Their technique of collection and preservation was similar to that reported by Goodall. Aerobic and anaerobic cultures revealed that 22 per cent of the collections were contaminated by the bacillus subtilis, bacillus coli, staphylococcus albus, and bacillus pyocyaneus. Repeat cultures after two weeks in cold storage yielded results identical to those of the primary cultures. The authors believe that these findings contradict the belief of Goodall that the low temperature prevents growth or even kills the organisms.

It was concluded that, as the quantities obtained were so small and thus necessitated so much handling, the placenta was not a practical source of blood for transfusion. The positive cultures which were still positive after a period of two weeks in cold storage were believed to contraindicate the use of this means of preservation.

THOMAS C. DOUGLASS, M.D.

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE; POSTOPERATIVE TREATMENT

Lassen, H. K.: I. The Prognostic Significance of Pre-Operative Investigation of the Vital Capacity. II. The Influence of Various Operations and of Postoperative Complications on Vital Capacity. *Acta chirurg. Scand.*, 1938, 81: 343, 361.

The vital capacity is the amount of air that a patient can expel after a full inspiration. This capacity was estimated in a total of 464 surgical patients. Three hundred and fifty-nine were operated upon and 33 died. One hundred and ninety-nine of the 359 who were operated upon had a lowered vital capacity. In 230 an electrocardiographic study and an x-ray examination of the heart were made, in addition to the estimation of the vital capacity. Apparently, postoperative pneumonia occurred just as frequently whether or not the vital capacity was lowered. On the other hand, a lowered vital capacity seems to indicate a rather greater chance of the occurrence of phlebitis, infarct, or embolism. Examination indicated that normal conditions were present in 69 of the patients operated upon. Only 1 died as a result of circulatory insufficiency. The autopsy, however, revealed the heart to be normal.

The vital capacity was normal in 160 of the patients who were operated upon. Of these, only 2 died of circulatory insufficiency. Of the 230 patients who were operated upon and who had been examined by all the methods, 10 died of circulatory insufficiency. The author was able to predict, at the most, only 1 of these deaths from an ordinary examination of the heart; only 5 deaths by means of electrocardiography; only 7 by means of x-ray examination of the heart; and only 8 by means of estimation of the vital capacity. The mortality occurring as a result of circulatory insufficiency in the cases of patients with lowered vital capacity alone was found to be 5.2 times greater than in those with normal vital capacity. The mortality from circulatory insufficiency is 4.6 times greater when only one of the tests in question shows a pathological condition than when all the tests show normal conditions. When all the tests show pathological conditions, the mortality resulting from circulatory insufficiency is about 12 times greater than when conditions are normal. Each laparotomy lowers the vital capacity, and the higher the incision in the abdomen, the more the capacity is lowered. On the contrary, the vital capacity is not influenced by operations on the extremities; nor is it influenced to any great extent by various kinds of narcosis and anesthesia, in uncomplicated cases.

Complications such as bronchitis, pneumonia, and infarct, further lower the vital capacity, according to the degree of complication. These complications also draw out considerably the period that elapses before the vital capacity again becomes normal. In some cases, the injection of morphine has no influence on the amount of the vital capacity estimated; in other cases a slight increase results. It must therefore be concluded that pain in the wound itself does not play so great a part in the lowering of the postoperative vital capacity as does the reflex muscular spasm. MANUEL E. LICHTENSTEIN, M.D.

Rendano, C.: Zambrini's Salivary Reaction and Its Applications in Surgery (La ptialo-reazione dello Zambrini e le sue applicazioni in chirurgia). *Riv. di chir.*, 1938, 4: 537.

The basis of Zambrini's salivary reaction rests on the peculiar character communicated to the humoral fluids by the constitution, on the influence exerted on these fluids by pathological conditions, and, in general, by the changes in humoral equilibrium of the organism. The reagent used consists of: cochineal red, 1 gm.; trioxyanthraquinone, 1 gm.; dioxyanthraquinone, 7 gm.; rubia tincture, 1.30 gm.; and 95 per cent alcohol, 1,000 gm. For the reaction, 1 c.cm. of total saliva is mixed with .33 c.cm. of the reagent; the mixture is well shaken and its color serves to show the degree of vital resistance of the organism. The color varies from very light yellow to dark violet passing through various shades of red: the lightest colors correspond to the lowest degrees of the scale established by Zambrini and to the lowest clinical values. Even in the lightest colors a violet smokiness indicates a tendency toward improvement. In healthy subjects, the mixture is limpid; turbidity indicates pre-existing disease or, during puberty, a change in the constitution. Sediment is due to disintegration of vital substances caused by the disease and is proportionate to the gravity of the morbid condition. A golden-yellow halo, seen by tangential light at the superficies of the mixture, is found in all cases of infectious disease capable of producing toxins, and its intensity is proportionate to the decrease in the defensive powers of the organism.

On the basis of a study of 200,000 cases, Zambrini has established 4 classes of vital resistance: (1) values between 16 and 13 of his chromometric scale —excellent; (2) values between 12 and 9—satisfactory; (3) values between 8 and 5—bad; and (4) values between 4 and 1—very bad. Various authors have used the reaction in different fields and have reported satisfactory results.

Rendano has performed the reaction in 100 surgical cases for three or four days before the intervention, taking readings thirty minutes and again twenty-four hours after making the mixture and establishing an average for the readings in order to formulate an operative prognosis. He found marked agreement between the pre-operative data, given by the reaction, and the general condition of the pa-

tients as evaluated by the clinical examination. The pre-operative prognosis as to postoperative complications corresponded to the 4 classes of vital resistance established by Zambrini, which for prognostic purposes can be termed: excellent, good, reserved, and unfavorable. Infected surgical cases with closed suppuration form an exception to this rule because they take a particular course. In aseptic cases in which the postoperative course is normal, the postoperative curve of the salivary reaction is characteristic: after an initial fall on the first day, it rises gradually to reach its original height about the tenth day. The curves show that morphine has an immediate depressing action on the vital resistance. If a curve presents marked oscillations with low points which last several days, a local or general complication that is arising or has already arisen must be suspected. In cases of simple inflammatory reaction or of suppuration, a fall in the curve always precedes the appearance of clinically demonstrable signs by one or two days, and the curve returns promptly to normal when the pus is evacuated. The turbidity, sedimentation, and halo generally run a course parallel to the chromometric values.

RICHARD KEMEL, M.D.

Schoen, R.: Pharmacology and Special Therapy of Circulatory Collapse (Pharmakologie und spezielle Therapie des Kreislaufkollapses). *Verhandl. d. deutsch. Gesellsch. f. Kreislaufforsch.*, 1938, p. 80.

The experiences of the late war have led to concentrated efforts directed against circulatory collapse. Camphor and adrenalin in new forms are today still the principal means used to bring back into active circulation the blood stagnating in the great venous reservoirs; however, the search for other preparations, experimentation, and clinical observations are by no means at an end. The desired elevation of the blood pressure is an expression of the transference of the blood to the arterial side and presupposes an increase in the cardiac efficiency and the re-establishment of the vasomotor tonus. The ideal preparation for conditions of collapse is that which transfers the blood from the venous side back into its normal channels, without regard to whether it produces any marked increase in the blood pressure or not. The author discusses clinical experiences and animal experimentation (including that done on decapitated animals), the results of which are far from clear when applied to the normal human heart and vascular system, and especially when applied to the diseased human heart. In trying out the various new preparations we still lack an appropriate basis of comparison, because of the dosages employed and because of indirect pharmacological effects.

Preparations to combat collapse are divided, according to their principal point of attack into the cerebral-analeptic and the peripheral acting types. The former are spasm-exciting, they produce paralysis in large doses and affect the central nervous system; the latter have a direct tonic effect upon the peripheral vessels. Adrenaline, ephedrine, and veritol produce their effects by way of the various attachments of OH-groups to the benzol nucleus with a side chain of 2 C with an amino terminal group. All these preparations stimulate the sympathetic system. The effects of adrenaline are transitory; a practical method of prolonging its action is by means of the continuous drip-infusion and the addition of very small amounts of adrenalin, from 0.1 to 0.3 mgm. The action of sympatol is similar, only 100 times weaker. The best of all so far has been veritol, particularly because of its therapeutic applicability and favorable influence on the heart, especially in cases of postoperative collapse. It is given intramuscularly in doses of from 10 to 20 mgm. The author appends 4 charts showing the systolic and diastolic blood pressure and the pulse rate in man, with suprifan, subcutaneously; with veritol, intravenously; and with pervitin, subcutaneously and per os. So far this group of adrenalin-like, sympathetic-stimulating preparations has exhibited a perplexing diversity of action with reference to duration and intensity of action, dependability upon oral administration, ratios of intensities of vascular and cardiac effects, preponderance of effects on the veins or on the arteries, and the danger of secondary effects, especially on the heart. Intravenous administration is best avoided. So far the best resuscitating preparation acting by way of the brain has been camphor in the form of cardiazol. This is true because of its effects on the circulation and respiration; however, the action is brief; of somewhat longer duration is the effect produced by coramin. There is nothing essentially new in neospiran and in cykloton; caffein also has powerful peripheral effects. Practically there is justification for regarding acute impending collapse as a separate entity; for treatment cardiazol given intravenously has its place; but in cases in which there is poisoning from carbon monoxide or from veronal, caution is demanded because of the latent tendency toward spasm. If the cardiazol is not effective within a short time, other preparations which act on the peripheral circulation, such as veritol (subcutaneously), should be tried. Especially advantageous is the simultaneous, or alternate administration of doses of centrally and peripherally acting preparations. Preparations in which both centrally and peripherally acting drugs are already in mixture, such as tioral, are to be avoided. The special treatment of the individual collapse condition is based upon the results of experimental researches and clinical experience. Cerebral analeptics are recommended in cases of collapse during narcosis, with toxic conditions of the central nervous system, with loss of adaptive response of the vasomotor apparatus during convalescence, of hypotonic states, of orthostatic collapse, of fainting, of hypoglycemic shock, and of collapse from lack of oxygen under diminished atmospheric pressure (sickness from high altitudes), in which coramin given intravenously is especially valuable. In infectious cases excellent

results may be procured both by the centrally, and the peripherally acting substances, given either together, or alternately. In the absence of cerebral involvement the peripherally acting preparations, because of their generally more persistent effects, are to be preferred. Appropriate as a prophylactic agent against collapse in infectious cases is ephedrine given per os. In instances of postoperative collapse, including those following spinal anesthesia, as well as all severe conditions with damage to the peripheral vascular system, the treatment is the administration of a peripherally acting preparation by injection, and when there has been loss of blood, by infusion. In these cases sympatol and veritol should receive first consideration. In the treatment of the milder instances and for prophylaxis, administration per os should be considered. Central excitants should not be employed in fresh instances of poisoning by war gas.

An extensive bibliography is appended. From the discussion in which 11 workers took part and according to the author himself, it is evident that, in such a short review, not more than a few guiding principles could be touched upon; also that as regards the effect of veritol on the human being, opinions still differ greatly. (EGGERT). JOHN W. BRENNAN, M.D.

ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

Sheplar, A. E., Spence, M. J., and MacNeal, W. J.: Serum Therapy for Infections with Streptococci: General Observations. *Arch. Surg.*, 1938, 37: 772.

The authors continue their observations on the serum therapy of hemolytic and non-hemolytic streptococci. Four earlier articles have dealt with the general technique of treatment and have presented the records of 26 patients. The present report is based on the cases of 66 additional patients. Eighteen of these died and 48 recovered, the mortality amounting to 27.3 per cent. Most of the patients had been referred to the authors, and treatment was begun when they were already desperately ill. No attempt was made to select cases; those with evident meningitis and peritonitis were included with those which were less severe. The age of the patients varied from nineteen days to eighty years. The sera used were the concentrated streptococcus serum of the New York State Department of Health, the unconcentrated streptococcus serum of the New York State Department of Health, and the concentrated streptococcus serum, biological 2005, of Parke, Davis & Company. No single preference is expressed. Of the total amounts given, 804,400 units of the New York State serum and 340 c.cm. of the Parke, Davis & Company serum were maximal, although much smaller totals were customary. Test doses of 0.1 c.cm. of 1:10 dilution were first given intracutaneously; if no reaction occurred, increasing amounts of the same dilution were given subcutaneously, then intramuscularly. Increasingly potent doses were given intramuscularly, and finally the undiluted serum was given intravenously.

If, shortly after the administration of serum, the patient experienced chills, a sudden rise in temperature, diaphoresis, and then a fall in temperature, the authors regarded the reaction as favorable. Such a response, so often observed in the treatment of sepsis when an adequate amount of antibacterial agent (be it a chemical, bacteriophage, or serum) has been introduced into the blood stream, is designated by the authors as the Hugh Young reaction, since it was he who described it in association with the intravenous administration of mercurochrome in septic patients. They believe that such a visible reaction is the external manifestation which indicates a turning of the balance in the fight between the bacteria and the protective forces of the body, and that it is probably due to an injury inflicted on the invading bacteria by the therapeutic agent. Conditions successfully treated include cellulitis of various regions, otitis media, mastoiditis, pneumonia, and a case of mediastinitis. Surgical drainage was employed when indicated. Many of the patients were also treated with sulfanilamide, bacteriophage, and multiple transfusions. A combination of serum therapy with these agents seems promising.
A. F. JONAS, JR., M.D.

ANESTHESIA

Balme, H.: The Treatment of Pain in Severe Injuries. *Practitioner*, 1938, 141: 757.

The author urges that treatment be given for pain in severe injuries. He prefaces his article with some remarks upon the unpreparedness of the practitioner of medicine for the severe accidents which occur during warfare and calls attention to the extreme importance of the care of pain in war injuries. Traumatic pain may be divided into three parts: the initial pain resulting from the accident itself; the pain produced and aggravated by movement, friction, or exposure during the first-aid treatment or transport; and the reactionary pain which occurs after some hours or days because of inflammatory processes or local pressure.

In his opinion the pain caused by the original injury should be treated with morphine or dilaudid. During transport it is extremely important that the injured part is kept at rest. He emphasizes that traction alone is not sufficient to keep the part at rest, but that support is often required. The suturing of wounds should always be carried out under an anesthetic even if only a local anesthetic is used. The third type of pain, which is due to inflammation or the tension of constricting bandages, should be treated by the evacuation of hematomas or pus.

In the treatment of burns in infants and children, he believes that the tincture of opium is most valuable, while in the adult, morphine should be used. In the treatment of burns due to mustard gas, lavage of the burned area, as well as of areas not burned, should be carried out with water con-

taining bleaching powder, and the surgeon himself protected during the procedure. He also recommends the use of analgesics in the treatment of burns and injuries of the eyes.

WILLIAM C. BECK, M.D.

Dénier, A.: Electrical Anesthesia (L'électro-narcose). *Anes. et anal.*, 1938, 4: 451.

Dénier reviews the history of experiments in obtaining anesthesia with interrupted electrical currents of low tension. In common with other investigators, whose work he discusses, he has found it impossible to produce anesthesia without producing contractures and convulsive movements with interrupted currents. In experiments on rabbits with interrupted high-frequency currents, it was found possible to obtain anesthesia without contractures or convulsive movements by varying the tension, the frequency, and the space of interruption; a frequency of from 85,000 to 120,000 per second with a tension of from 20 to 45 ma. and interruption of from 1.5 to 13.5 sigmas was found to be most favorable.

Some experiments have been conducted on man, but not with a view to producing surgical anesthesia. The author is not certain that this method is applicable in this field. In some psychopathic patients, he has found that the application of the interrupted high-frequency currents of low tension with frontal and occipital electrodes has had a favorable effect on the electro-encephalogram and has induced a state of euphoria clinically. These currents also have a vasodilating effect, and the author has observed cases of ischemia, arteritis, and gangrene successfully treated with this type of current at Leningrad.

He has himself treated 2 cases of obliterating arteritis of the lower extremities by this method with good results, especially in consideration of the fact that other methods of treatment previously used (including sympathectomy) had failed to produce any improvement. ALICE M. MEYERS.

Kelman, H., and Abbott, G. A.: Toxic Myelopathy (Spinocaine). *Ann. Surg.*, 1938, 108: 1001.

The authors state that severe myocardial disease, hypertension, marked hypotension, and psychoneuroses have been considered contraindications to spinal anesthesia, and on the basis of 5 untoward reactions following spinal anesthesia they believe there are other contraindications.

Following the injection of an anesthetic medium into the subarachnoid space a reversible reaction occurs in the nerve cells. There are certain traits which may interfere with the normal reversibility of this reaction. These traits, they believe, are the congenital anomalies in general, particularly those of the central nervous system, as well as diseases of that system; congenital anomalies and diseases of the circulatory system, such as a tendency toward, or the presence of, varicosities, endarteritis, or phlebitis; and congenital anomalies and diseases of the skin and epidermal appendages, such as pilonidal cyst, with which spina bifida occulta is often associated.

The importance of severe neurotic traits as a contraindication to the employment of spinal anesthesia was emphasized. All of the patients had a cauda-equina neuropathy or lumboneuropathy following the anesthesia. In most of the cases it remained for a considerable time, and in some it has remained permanently. WILLIAM C. BECK, M.D.

Cordier, D.: The Problem of Anesthesia in the Wounded Who Are Gassed (Le problème de l'anesthésie chez les blessés gazés). *Anes. et anal.*, 1938, 4: 429.

In recent years the question of anesthesia for wounded persons who are gassed has been a subject of discussion at congresses and conferences. Yet, Cordier notes, there are very few experimental studies that might guide the surgeon in such conditions. The various war gases employed act upon the mucosa of the respiratory tract, including the lungs, as well as upon other tissues. They have a destructive action on protoplasm, and may cause congestion, edema, or suppuration in the lungs and in the upper respiratory tract.

From a review of the literature on the subject Cordier concludes that: local or regional anesthesia should be used whenever possible. The question of the preliminary use of sedatives in gassed patients deserves further study; there is considerable difference of opinion as to the dangers of such drugs as morphine and scopolamine in these cases. Spinal anesthesia should be reserved for gassed patients without hypotension when the lower extremities are operated upon. When local or regional anesthesia cannot be used, fluid anesthetics given by intravenous injection or by rectal instillation should be given preference over inhalation anesthesia. It is difficult to determine whether evipan or avertin should be given the preference for this type of anesthesia; German authors incline to favor the former, because of the simple technique for its administration. Further experiments are necessary to determine under what circumstances inhalation anesthesia may be employed in persons who have been gassed; all authorities are in accord in stating that volatile anesthetics should not be employed in these cases. ALICE M. MEYERS.

PHYSICOCHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Kawaishi, K.: Studies on Roentgen Cinematography of the Internal Organs and of the Circulation of the Blood in the Human Body. *Am. J. Roentgenol.*, 1938, 40: 913.

With the aid of a specially constructed unit, which he describes, the author conducted many experiments to determine the optimum conditions for roentgen cinematography by the indirect method of filming the image appearing on the fluoroscopic screen. He endeavored to ascertain: (1) the optimum intensity and dosage; (2) the wave of light which has the highest intensity, as revealed by spectra of fluorescence of fluorescent and strengthening screens; (3) the relation between films and screens; (4) the sensitivity of various films; (5) the speed of filming; and (6) the limitations of dosage to avoid bad after-effects. The results of these studies are discussed and some of them are portrayed graphically.

For practical use, some of the conclusions reached are as follows:

1. A screen consisting of a mixture of zinc sulphite and cadmium sulphite is best.

2. The optimum intensity and dosage for roentgen cinematography of the stomach, intestine, pelvis, and ureter of the human, are 125 kv. (peak) and 50 ma. For the chest, 110 kv. (peak) and 50 ma. are sufficient.

3. The maximum speed for cinematography of the human chest is 30 frames a second; the optimum speed for the esophagus is 16 frames; for the stomach, gall bladder, and intestines, from 4 to 8 frames; for the pelvis and ureter, 8 frames; for the blood circulation of the extremities, with opaque substance, 50 frames a second. ADOLPH HARTUNG, M.D.

Brunschwig, A.: Observations on the Changes Occurring at Benign Giant-Cell Tumor Sites Several Years Following Treatment by Conservative Measures. *Am. J. Roentgenol.*, 1938, 40: 817.

In the past fifteen years, conservative measures in the form of local resection, curettage, and irradiation, either alone or in combination with surgical procedures, have in general replaced amputation or radical resection in the treatment of giant-cell tumors. Thus, it has become established that giant-cell tumors are essentially benign lesions, but it is likewise recognized that they may become the sites of malignant neoplasms which metastasize and kill the patient.

Since conservative management has now been generally practiced for a number of years, it is perhaps of interest to consider what may be expected to occur at the sites of these tumors several years following such treatment, in cases in which sarcoma of one type or another has not developed.

Such investigation made by the author showed that following roentgen therapy alone a gradual re-ossification, first about the periphery and then extending centrally, takes place. Areas of reduced density may persist unossified for years. A new dense cortex does not re-form over the tumor site. Evidence is presented to indicate that such ossification is due principally to metaplasia in the tumor, which is an effect of the irradiation. When the lesions are intramedullary, new bone formation may also occur as a result of endosteal activity in the adjacent cancellous bone, and from the inner surface of the overlying shell.

Following curettage (with or without roentgen therapy), the changes are not those occurring in tumor tissue, but in the large blood clot which develops subsequent to operation. This becomes organized by dense fibrous tissue, and when the tumor site is large, small fluid-containing cavities persist throughout the region. At first, new bone develops about the periphery of the site, and a well-defined cortex is re-formed. Permeation of cancellous bone into the organized hematoma is very slow and may take place only to a limited extent. There may be a latent period of several years before considerable central re-ossification develops, although endosteum is always present over the bone adjoining the site. In small giant-cell tumors, re-ossification throughout the tumor site usually occurs.

The fact that abnormalities in the bony architecture will persist in the absence of active tumor tissue for years following curettage and roentgen therapy, each alone or in combination, is of importance in evaluating roentgenograms taken in follow-up studies. JOSEPH K. NARAT, M.D.

Martius, H., and Kroening, F.: The Question of Inheritance of Injuries from Roentgen and Radium Irradiation (Zur Frage der Erbgutschaedigung durch Roentgen- und Radiumstrahlen). *Med. Welt*, 1938, p. 947.

This article was written in response to inquiries from members of the medical profession. The problems here treated are: may the germ cell be injured by exposure to the roentgen ray, and what dosage of roentgen rays is to be used for purposes of diagnosis, in regions of the human body involving the genital glands, without danger of injury to those components of the germ cell which carry the inherited characteristics (artificial mutation)?

Studies on the subject of genetics in reference to irradiation have shown that mutations produced by the roentgen rays follow the same laws and apply to all cells throughout the whole realm of living nature; and not merely in the germ cells but also fundamentally in the somatic cells.

The changes in the inherited biological characteristics produced by roentgen and radium rays are

the mutations. These are markedly increased by irradiation of the genital glands. The production of mutations stands in direct relationship to ionization, i.e., to the number of roentgen units which reach the genital glands, since the number of roentgen units is a measure of the amount of ionization. So far mutations have not been produced by irradiation with the longer wave-lengths. There is no threshold-dose for the induction of mutations by roentgen and radium rays, either in relation to the length of the wave, or to the dosage employed; consequently even the very smallest dosage of any sort of short-wave, ionizing ray may induce mutation. Mutation is independent of the chronological distribution of the total dosage, and consequently it does not matter whether the genital gland is subjected to high intensities for a brief interval, or to lower intensities throughout a longer period of time, i.e., whether the irradiation is carried out by the protracted or by the fractionated method. The single irradiation insults have a summating effect in the matter of starting mutation processes, and this, not only in the individual throughout life, but for a term of generations if the individual does not die without issue. Herein lies the problem of irradiation with regard to race-hygiene. The mutations of irradiation are irreversible, and herein the changes produced by the roentgen rays in the heredity-carrying component differ essentially from the changes produced in the other body-tissues, since both induced and spontaneous mutations signify a transition from one stable condition of the gene to another stable condition. Consequently a study of the blood-picture is no criterion as to the possibility of mutation having been induced in the genital glands.

On the basis of the studies of Timoféeff, somatic induction, i.e., indirect injury to the reproductive glands from irradiation of the neighboring regions of the body is to be denied; nor do mutations occur when only the germ plasm, not the nucleus of the cell which is the bearer of the inheritance-carrying substance, is the part affected. This is of practical importance in view of the fact that minimal dosages of roentgen rays may so injure the follicular apparatus and the plasma of the ovum that the rut, or heat-cycle in the animal may exhibit abnormalities. A small dosage of irradiation preceding a large dose does not result in a higher mutation rate than when both irradiation dosages are given simultaneously; the sum of the irradiation-ionization effects to which the heredity-bearing substance has been subjected in the course of time is always the determining factor.

All the results of the study of the genetic effects of irradiation on plants and animals are not as yet of practical evaluation with regard to the human being as the injury induced by the roentgen rays is recognizable only after several generations. For this reason direct proof of an injurious effect of the short-waves is not yet at hand since our period of observation, compared with the duration of a generation in the human being, is too brief. Consequently if a normal child is borne by an irradiated mother, it should not be concluded that danger of injury to the heredity-factor is not present.

Experimental studies by the authors (*Deutsche med. Wchnschr.*, 1936) have shown that the diminished percentages of successful matings in guinea pigs, following irradiation with extremely small dosages, were obtained not only in the parent animals but in the daughter animal of the irradiated mother (F_1 generation) as well. In these cases the dosages were from 5 to 50 roentgen units, which extend to well within the range of the dosages incident to roentgen diagnosis. However, changes in the genes were not involved in this study but rather injury to the germ plasm. In reference to the tolerance dosage of 3 roentgen units as given by Pickhan, it is pointed out that this dosage was determined for the human being merely by analogy from results obtained on the drosophila; furthermore, there is no irradiation dosage which may be regarded as unharmful to the heredity-bearing substance; and the individual dosages of less than 3 roentgen units are in their effects fully summative.

The roentgen dosages which in practice reach the deeper regions of the pelvis in diagnostic fluoroscopy are given, and it can be seen that the series fluoroscopic examinations employed in the diagnosis of intestinal conditions meet the tolerance dose of 3 roentgen units. For this reason the greatest caution is required in all cases in which irradiation is given in the immediate vicinity of the reproductive glands. The total exposure should be limited to show only what is absolutely necessary. It must also be considered that "soma" mutations, particularly cancer mutations, may be induced by short-wave irradiation. This fact was demonstrated by experiments on mouse-tumor strains in which the whole body was irradiated. Therefore, the roentgen-ray is not only a medium in the fight against cancer; it is also a medium for the induction of cancer. The effects of secondary rays, either in diagnostic or in therapeutic amounts, upon the gland which does not lie directly in the path of the primary rays, do not equal those of 3 roentgen units and are therefore not of practical importance.

The authors conclude that, in roentgen and radium therapy in gynecology, the ovary of the woman should be protected from every type of irradiation while there is still the chance of offspring, especially since the therapeutic effect sought, the weak dosages for ovarian insufficiency, or the irradiation treatment of inflammatory processes, in most instances, is attainable with therapeutic measures which have no bearing on race-hygiene. As for the rest, results from irradiation are not in general so striking that we can afford to risk in their behalf an increase in the total number of mutations in the general population. However, in many cases roentgen diagnosis is indispensable, and the question of injury to the heredity-bearing substance by roentgen and radium rays in amounts indispensable in practice is, in the

opinion of the authors, less an individual problem of the immediate future, than a problem of race-hygiene for the more distant future of the entire population. Therefore, the authors strongly advocate that roentgen and radium rays, in dosages insufficient to produce definitive sterility, should insofar as at all permissible in view of the practical needs of diagnosis and therapy, be dispensed with, and also that the personnel entrusted with the administration of irradiation treatments should be protected from the danger of irradiation-injury by technical protective appliances, so that we may not be reproached by future generations for not having exercised sufficient care.

(F. Siegert). John W. Brennan, M.D.

RADIUM

Engelstad, R. B.: The Treatment of Lymph-Node Metastases from Carcinomas of the Lips and of the Oral Cavity. *Acta radiol.*, 1938, 19: 546.

In the Norwegian Radium Hospital 135 patients who had carcinoma of the oral cavity were treated from 1932 to 1935. Seventy-two of these had carcinoma of the tongue, and 63 had carcinoma of the gingiva, the palate, or the lip. Of the total group 32.6 per cent were free from symptoms from two and one-half to six years after treatment. Among the 54 patients who had no glandular metastases 61.1 per cent were free from symptoms for from two and one-half to six years; only 17.4 per cent of 81 patients with glandular involvement were free from symptoms. In the treatment of lymph-node metastases the best results were obtained from teleradium treatment with block dissection. The radium-skin distance used was from 5 to 10 cm.; epidermicidal doses were given, which resulted in exudative epidermitis. The total block dissection was done in the method of Roux-Berger.

During the same period 141 patients with carcinoma of the lip were treated, and of the total group 65.2 per cent were free from symptoms at the end of from two and one-half to six years. Of the patients without glandular metastases 87.7 per cent were well, whereas in the group with metastases 40.2 per cent were free from symptoms.

An analysis of the results of various methods of treatment demonstrates that the glandular metastases from carcinoma of the lip may often respond satisfactorily to teleradium treatment only. If the glands do not disappear after a period of from six to eight weeks following the radium treatment a total block dissection is done. Although it is sometimes possible to destroy metastases with teleradium treatment only in carcinoma of the oral cavity, in the majority of cases this treatment is not sufficient and must be combined with block dissection.

In regard to prophylactic treatment, the authors believe that it may be omitted in carcinoma of the lip if the patient can be carefully observed. In oral carcinoma they believe that prophylactic irradiation is important. Harold C. Ochsner, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Price, P. B.: Surgical Bacteriology and Surgical Technique, with Special Reference to Disinfection of the Skin. *J. Am. M. Ass.*, 1938, 111: 1993.

The bacterial flora of normal skin is found to be composed of "transients" and "residents."

Transients, which are collected from extraneous sources, may be present in enormous numbers at times, but as a rule relatively few are present on grossly clean hands or on clean protected (unexposed) skin.

The size of the basic (or resident) flora at any given time is the net result of factors constantly acting, some to increase, others to decrease, the bacterial "population." Increase results largely from multiplication of resident organisms already present. Decrease is brought about by washing, friction of clothing, and influences deleterious to bacterial life.

The basic flora includes some pathogenic bacteria. If hands are in frequent contact with contaminated objects, a dangerously large proportion of the resident bacteria may be pathogens. In such cases it is almost impossible to disinfect the hands. In this hitherto unsuspected manner a person may become a carrier of virulent organisms. The basic flora of protected skin per unit area is no smaller than that of the hands.

Scrubbing with brush, soap, and warm water reduces this basic flora at a constant rate. Irrespective of the initial size of the flora, the number of bacteria is reduced by approximately one-half with each six minutes of scrubbing. The kind of soap used makes no difference. Variations in the temperature of the water used has no appreciable influence on the rate. The amount of vigor used in brushing is a very important factor, however. Sterile water has been found to possess no advantage over ordinary tap water in reducing this flora.

Ethyl alcohol has a very narrow range of effective germicidal concentrations. The optimum germicidal strength, both *in vitro* and on the skin, is 70 per cent by weight (not by volume as ordinarily prepared). At precisely this concentration, alcohol is more effective than any other hand disinfectant now in general use. Each minute spent in this particular solution (at 25° C.) has a cleansing effect equivalent to about six and one-half minutes of scrubbing. This effect may be increased considerably by friction, i.e. by rubbing with gauze or a wash cloth.

Mercury bichloride solutions do not reduce the flora on the skin appreciably. Paradoxically, a sterile cutaneous surface may be produced. This phenomenon is due to the formation of a transparent "film" on the skin under which the bacteria are imprisoned. There, conditions are so suitable to life that multiplication takes place, the existing flora doubling every fifty minutes. The "film" may be broken up, either with an alkaline sulfide or by prolonged friction, whereupon the bacteria are released uninjured.

The same phenomenon is observed when potassium mercuric iodide (biniodide) or Harrington's solution is used. Neither of these is a true germicide when applied to the skin. When tested, these agents should always be followed by an alkaline sulfide.

Kelly's method of hand disinfection (with hot saturated solutions of potassium permanganate and oxalic acid) is very effective. The procedure requires from two and one-half to more than five minutes, depending on the temperature of the solutions. The total cleansing effects are equivalent to between twenty and thirty minutes of scrubbing.

The lime and soda method is also very effective. When rubbing with the paste is continued for four minutes the reduction of flora is as great as could be accomplished by twenty minutes of scrubbing.

Saponated solution of cresol, though a relatively strong germicide against test organisms *in vitro*, proved a worthless disinfectant of the skin.

A search for a more nearly ideal hand disinfectant has resulted in the production of a new germicidal mixture which seems to possess certain advantages over any of the agents in general use. It is powerfully germicidal, each minute spent in it (at 25° C. without friction) being equivalent to more than eleven minutes of scrubbing. It is simple and pleasant to use. It does not irritate or injure the skin. It is more stable than simple ethyl alcohol solutions. This germicide consists of ethyl alcohol 50 parts by weight, normal propyl alcohol 20 parts by weight, and water 30 parts by weight. It may be prepared as follows: ethyl alcohol (95 per cent) 675 c.cm., pure n-propyl alcohol 250 c.cm., and distilled water 250 c.cm., all measurements being made at 25° C.

Freshly prepared (U.S.P.) tincture of iodine (7 per cent), applied to grease-free skin and followed by an antidote, comes nearer to full sterilization of the epidermis than any other germicide tested.

From bacteriostatic and bacteriocidal standpoints, mercurochrome is in many respects similar to the inorganic salts of mercury.

Pre-operative preparation of the hands. The following procedures are recommended:

1. The hands are scrubbed with soap, a good brush, and warm water for at least seven minutes. This will usually suffice to remove gross dirt, transient bacteria and fats, and incidentally about half the basic flora.

2. The resident flora is much more effectively attacked by germicides than by scrubbing. Ethyl alcohol, 70 per cent by weight, or the mixture of alcohol described is recommended. These solutions should

be freshly and accurately prepared. Before entering the alcohol basin, the hands and arms should be dried thoroughly with a sterile towel, for to carry water into alcohol would weaken the solution and markedly lessen its germicidal power. In the alcohol basin the skin should be rubbed firmly with sterile gauze or a wash cloth.

The time spent in these solutions is of the utmost importance. Ethyl alcohol should be used with friction for three minutes by the clock, or the mixture of alcohols for two. This may be expected to reduce the original flora from 50 per cent (result of scrubbing) to something less than 2 per cent.

3. Gloves and gown are put on. An ungloved hand inevitably increases the risk of wound infection.

4. Between operations the hands should be washed in a germicidal solution in order to counteract the increase of cutaneous bacteria which has taken place beneath the gloves. A useful rule is one minute in alcohol for every hour that the gloves have been worn.

Preparation of the field of operation. Before coming to the operating room the patient should receive a bath, the site of operation being especially well washed with soap and water to remove dirt, most of the fats, and any transient bacteria. If, as in the presence of a wound, this is not possible, a chemical detergent should be used.

Immediately before the operation the site of the incision should be washed with gauze and 70 per cent (by weight) alcohol or the suggested mixture of alcohols. It should be allowed to dry slowly, for in disinfection time is a factor that cannot be ignored.

The alcohol is to be followed by one of the stronger germicides. U. S. P. tincture of iodine (7 per cent) is extremely effective. After application, iodine solutions should be permitted to dry slowly. Washing a dried coat of iodine off the skin with alcohol increases rather than diminishes the total germicidal effect.

As an alternative to the iodine technique, the field of operation may be painted with Scott's alcohol-acetone-2 per cent solution of mercurochrome, or an irregular area such as that of a hand or foot may be soaked for a minute in 1:500 biniodide solution. In either case an aseptic surface will be produced. However, the line of incision must be first specially prepared (disinfected), else the knife will necessarily pass through bacteria-laden skin beneath the "film." One way to do this is to rub the site of incision for two or three minutes firmly with gauze and 70 per cent (by weight) alcohol or the mixture of alcohols.

Disinfection of contaminated hands. It is not difficult to disinfect ordinary hands, contaminated by contact with infectious patients or materials. The following method is recommended:

1. The hands should be washed as soon as possible with soap and running water for at least thirty seconds. This may be expected to remove about nine tenths of the contaminating organisms. If there is pus, blood, secretion from the wound, saliva, mucus, or other infectious material on the hands, washing should be continued for a minute or more, perhaps with the use of a brush.

2. The hands should be well dried on an individual towel.

3. Every part of the hands should be wet with 70 per cent (by weight) alcohol. A few cubic centimeters dripped on the hands will suffice. The alcohol should not be wiped or shaken off but the skin should be allowed to dry by evaporation. It is the germicidal action that is required, and that takes time.

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Grodinsky, M.: Infection and Gangrene of the Extremities in the Diabetic. Diagnosis and Treatment. *Am. J. Surg.*, 1938, 42: 339.

The discussion of this subject is accompanied by 12 case reports. The author emphasizes the necessity of the closest co-operation between the internist and the surgeon. The determination of the form of surgical treatment, which varies from the most conservative régime to the most radical high amputation, depends upon the extent of infection and the adequacy of the circulation. Simple clinical examination of the pulsation of the peripheral vessels, the character of the local lesion, the color of the skin, and the skin temperature is the best means of determining the status of the circulation.

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